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ERRATA AND ADDENDA

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p.362, ℓ.5,	*delete* R.P. Southby, CMI 34813.
p.374, ℓ.41,	*for* 1969). *read* 1969; Sun and Huppert, 1976).
p.384, ℓ.14,	*for* CMI 34813 *read* R.P. Southby, CMI 34813
p.386, ℓ.33,	*for* (Fig. 5E) *read* (Fig. 6E)
p.390, ℓ.3,	*for* (Fis. 7A,7D) *read* (Figs. 7A,7D)
p.390, ℓ.26,	for M. *striatosporus* read M. *striatosporum*
p.413, ℓ.26,	*for* Gmnoascaceae *read* Gymnoascaceae
p.427, ℓ.11,	*for* Alaska *read* South Pacific
p.431, ℓ.2,	*for* (Figs. 13J-12L) *read* (Figs. 13J-13L)
p.452, ℓ.2,	*after* are divided by *add* thickened septa suggesting double septa (Figs. 17H,17I). Arthroconidia are cylindrical, cuneiform if terminal, discoid in end view, hyaline, later greenish-yellow, often with refractile end walls (Fig. 17K), 2-3 X 2-6µm, mostly 2-3 X 2.5-5.5µm. Chlamydospores are rare. No other spore state was observed.
p.456, ℓ.10,	*for* (UAMH 1942 and 1943) *read* (UAMH 1842 and 1843)
p.456, ℓ.17,	*for* UAMH 1941 *read* UAMH 1841
p.456, ℓ.18,	*for* 1943 *read* 1843
p.456, ℓ.28,	*for* (UAMH 1841, 1943 and 1975) *read* (UAMH 1841, 1843 and 1975)
p.458, ℓ.14,	*delete*
p.458, ℓ.15,	*for* (from Orr): UAMH 1941, Calif., Huppert (SFVH 129), Orr 0-3226) *read* UAMH 1841, originally from bronchoscopy specimen from patient with pulmonary disease not diagnosed as coccidioidomycosis, S. McMillen, Hektoen Institute, Chicago, (from Orr as Huppert SFVH 129, 0-3226)
.458, ℓ.16,	*for* UAMH 1942, Calif., Huppert (SFVH 130), (Orr 0-3283) *read* UAMH 1842, originally from bronchoscopy specimen from patient with pulmonary disease not diagnosed as coccidioidomycosis, S. McMillen, Hektoen Institute, Chicago, (from Orr as Huppert SFVH 130, 0-3283)
.458, ℓ.17,	*for* UAMH 1943, Calif., Huppert (SFVH 149), (Orr ?0-1088) *read* UAMH 1843, originally from sputum of patient with non-coccidioidal respiratory disease, S. Froman, Olive View Hospital, L.A., (from Orr as Huppert SFVH 149, ?0-1088)
.460, ℓ.25,	*for* (UAMH 1941, SFVH 129; *read* (UAMH 1841, SFVH 129;
.460, ℓ.26,	*for* UAMH 1942, SFVH 130; UAMH 1943, SFVH 149) *read* UAMH 1842, SFVH 130; UAMH 1843, SFVH 149)
.475, ℓ.39,	*for* Hubalek, A. *read* Hubalek, Z.
.481, ℓ.27,	*insert* Sun, S.H. and M. Huppert. 1976. A cytological study of morphogenesis in *Coccidioides immitis*. Sabouraudia 14(2):185-198.
.488, ℓ.15-ℓ.29,	*for* Fig. 21 *read* Fig. 22

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THE GENUS MARASMIUS IN THE NORTHEASTERN UNITED STATES AND ADJACENT CANADA[1]

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SUMMARY

The genus *Marasmius* (Basidiomycetes, Agaricales, Tricholomataceae), exclusive of section Chordales (7), is described as it occurs in the northeastern United States and adjacent Canada west to the Great Lakes region. Thirty species are included, representing sections *Androsacei, Epiphylli, Globulares, Sicci, Hygrometrici,* and *Marasmius*. Two of these species, *Marasmius fulvoferrugineus* and *M. robinianus,* are described as new. *Collybia cystidiosa* A. H. Smith & Hesler is transferred to *Marasmius,* and *M. lachnophyllus* Berkeley is treated as a variety of *M. cohaerens* (Persoon ex Fries) Cooke & Quélet. *Mycena albiceps* (Peck) Gilliam, *Collybia subnuda* (Ellis ex Peck) Gilliam, *Collybia dichrous* (Berkeley & Curtis) Gilliam, and *Collybia praeacuta* (Ellis) Gilliam are proposed as new combinations.

INTRODUCTION

Although a comprehensive theoretical framework for the taxonomic study of *Marasmius* has been laid by Kühner (13-15), Kühner & Romagnesi (16), and Singer (33, 36-39, 41), modern treatments are available only for European, Australian, and neotropical species. The pioneering work in North America of Pennington (25), Kauffman (11), and

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[1] Portion of a dissertation submitted to the Graduate School of The University of Michigan in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Morgan (22) did not include significant information about microscopic characters, which have become so crucial to modern taxonomy. With the growth of mycology in North America, additional taxa have been found for which published keys and descriptions are inadequate. The present work represents an attempt to treat the taxonomy of northeastern North American Marasmii, making full use of current ideas and practices as well as numerous recent collections.

MATERIALS AND METHODS

Macroscopic descriptions are based on notes from fresh material except where otherwise indicated. Color terms are those of Maerz and Paul (20), cited as "M&P"; Ridgway (28), cited as capitalized color terms; and the *ISCC-NBS Color Name Charts Illustrated with Centroid Colors* (12), cited as uncapitalized color terms. Sections of all specimens were studied microscopically in 2% KOH and in Melzer's reagent. The cresyl blue reaction of the pileus trama, which has been used in *Marasmius* taxonomy, did not always give consistent results when large numbers of specimens were studied and so is not reported here. Sections of fresh specimens were also studied in water. Colors of microscopic structures are described as they appear in fresh specimens in water mounts. Tangential and radial sections of the pileus with attached lamellae, as well as longitudinal sections of the stipe near the apex and base, were examined for structural composition and chemical reactions. Drawings were made with a Leitz Ortholux microscope and drawing tube. Structures are shown as they appear in sections or in squash mounts in 2% KOH or in KOH-congo red. Scanning electron micrographs were photographed using a Hitachi Hi-Scan model scanning electron microscope. Specimens were mounted on aluminum-base silver paint and coated with gold. Unless otherwise indicated by the appropriate symbol from the *Index Herbariorum* (10), all specimens are deposited in the University of Michigan Herbarium.

BIOLOGY

In temperate North America, Marasmii are found most frequently in woodland habitats. The largest number of species occurs in oak or oak-hickory woods or in deciduous-coniferous woods containing oak. Some species occur with regularity in stands of conifers. Beech-maple woods have relatively few Marasmii. A few species (e.g., *Marasmius* *minutus, M. uliginosus)* occur in swampy areas. The grassland Marasmii, which deserve to be explored in more detail, may fruit in otherwise dry and unfavorable habitats after a heavy rain. These, as well as the species that grow on litter of herbaceous dicots in open areas, are probably more abundant than the records indicate.

In the northeastern United States, Marasmii begin fruiting during mid-June, early July, or late August to early September. The first period begins slightly later in the northern areas, including Canada. Once the fruiting period of a particular species has begun, that species usually continues to fruit after each sufficiently heavy rain until late October to early November. Several times during the duration of this study an especially long, heavy rain in early September produced almost the entire *Marasmius* flora at once. In fact, attempts to collect spore-producing specimens of more than one or two species may be vain if there has not been rain during the day or at most two days before the collecting trip. Rain-dependent spore discharge in *Marasmius rotula* has been documented using a Kramer-Collins spore sampler (6).

In species whose vegetative mycelium can decompose different types of substrates, basidiocarp size and aspect may vary with the type of litter. For example, the largest basidiocarps of *Marasmius scorodonius* grow on pine needles. Smaller basidiocarps which do not differ microscopically grow on the bark of living trees. Still smaller ones may be found rarely on grass. This finding is consistent with Lindeberg's (17-19) discovery of marked differences in the growth of *Marasmius* mycelia under different nutritional regimes. Similar variations with substrate are found in *M. rotula* and *M. oreades*.

In dry or otherwise unfavorable conditions basidiocarps may fail to develop normally and may produce semi-gastroid basidiocarps. I have observed this in *Marasmius scorodonius* and *M. oreades*.

Little is known of the early development of basidiocarps of Marasmii. Kühner (14) described development of *Marasmius rotula* as hemiangiocarpous. He demonstrated that the hymeniform layer of broom cells was present from the beginning and that a cortina-like structure covers the developing lamellae until the pileus breaks away from the stipe. Although an attempt was made during the present study to section very young primordia (less than 1 mm in diameter), fully or almost fully differentiated tissues were always found. Radial free-hand sections of pilei from young to old were, however, instructive in interpreting the variation of many characters, particularly those of the pileus cuticle, and in understanding development past the primordial stage. In *Marasmius androsaceus*, for example, an almost uninterrupted layer of diverticulate hyphal end cells covers the surface of the primordium. In somewhat older pilei only the pileus edge and the central disc have many such cells. In still older pilei the original diverticulate hyphal cells have been so far separated by the expansion of the pileus that the cuticle appears in many places to be composed only of the incrusted subcutal hyphae. To ascertain whether or not diverticulate cells are present, it is necessary to cut a radial section and examine the extreme edge and the central disc. A similar situation occurs with respect to nodulose cells in the development of *M. scorodonius* (7). In *M. cohaerens*, the primordium is covered entirely by setae. These are eventually separated by broom cells with both long and short projections and finally by broom cells with short projections. In *M. delectans* young pilei have cuticles of strongly dextrinoid broom cells or seta-like elements which become separated in age by smooth, lobed, usually thin-walled, almost nonamyloid cells.

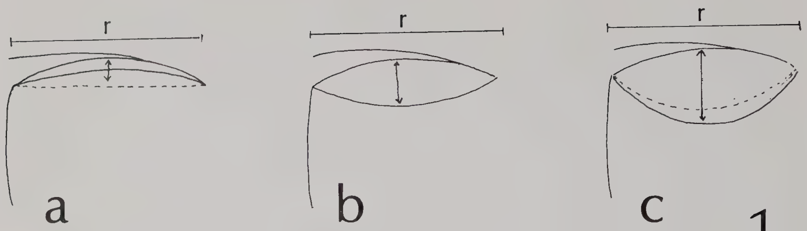
GENERIC CONCEPT

Fries established the genus *Marasmius* in the *Flora Scanica* (4). The concept first associated with the name *Marasmius* referred to species with white spores, central cartilaginous stipes, and reviving basidiocarps. A more complete presentation of the genus is found in his *Epicrisis Mycologici* (5). In the *Epicrisis*, *Collybia*, which has been the genus most difficult to separate from *Marasmius*, included species also having white spores and central cartilaginous stipes but with non-reviving (i.e., putrescent) basidiocarps. Fries characterized species of *Collybia* as having pilei with the margin incurved at first but did not cite a contrasting feature in *Marasmius*.

Since all of the published treatments of North American Marasmii follow Fries' concept, the majority of mycologists in the United States and Canada have been trained in this tradition. The primary objection to the use of Fries' concept involves the subjectivity of determining the ability to revive. Romagnesi (30) and Singer (36, 39) have commented on this difficulty. Several species usually considered as *Collybia* may also revive (1, 29). Therefore, in order to preserve the use of the revival character in generic determination, Kühner and Romagnesi (16) consider *Marasmius* to encompass the reviving species of *Collybia*. The problem is compounded, however, by species undoubtedly belonging to *Marasmius* but whose basidiocarps are far from tough and may fail to revive (e.g., *Marasmius felix, M. minutus, M. armeniacus)*.

Other generic concepts have de-emphasized the revival character and stressed microscopic features. Patouillard (24) established *Androsaceus* for species with broom cells and *Crinipellis* for species with long thick-walled hairs in the pileus cuticle. *Marasmius* under Patouillard's concept is reserved for species with cuticles having smooth, inflated hyphal end cells in a hymeniform arrangement or interwoven smooth hyphae. Dennis (3) restricts *Marasmius* to species in which the pileus cuticle is composed of broom cells or diverticulate hyphae. This concept seems not to reflect a natural grouping, since species in *Marasmius* section *Chordales* are not included. Some species in this section have cuticles composed of cells similar to broom cells when the basidiocarps are in the primordial stage but have cuticles composed almost entirely of smooth cells at maturity.

Based on extensive study of tropical, subtropical, and temperate species, Singer's (37 - 39, 41) classification of *Marasmius* reflects a more natural grouping. This is, with a few slight modifications, the concept employed in the present work. Singer's generic concept, using criteria other than revival, provides a practical way to separate *Collybia* from *Marasmius*. His concept includes species of the Tricholomataceae having the following combination of features: (1) white, nonamyloid spores, (2) no gelatinous layers in the pileus cuticle, (3) no prominently projecting amyloid or dextrinoid hairs or projecting cystidia (except setae) in the pileus cuticle, and (4) usually, hymeniform cuticles of smooth cells (e.g., fig. 14) or broom cells (figs. 4a & 4b). A few species with diverticulate hyphae in the cuticle (fig.9c) are included (*Marasmius* section *Androsacei*), but these have tough, horsehair-like stipes (figs. 3a & 3b) and black rhizomorphs. Species whose basidiocarps have cuticles of diverticulate hyphae and whose stipes have specialized hairs at the point of



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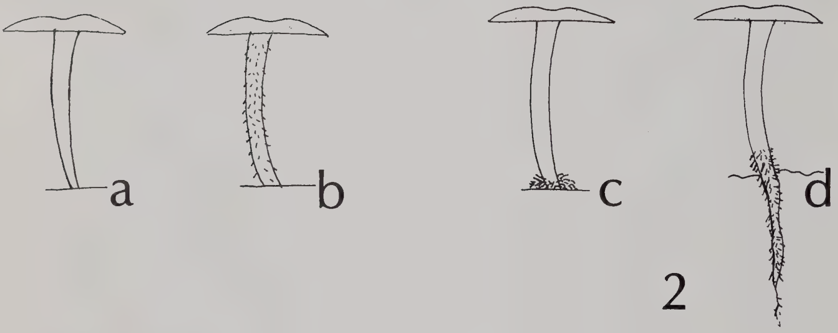

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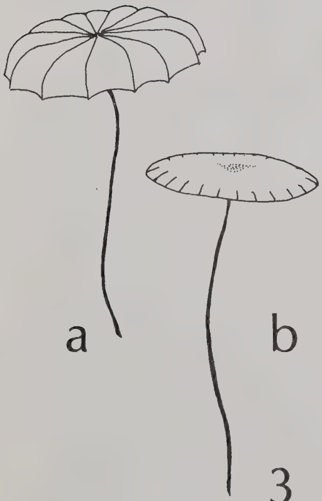

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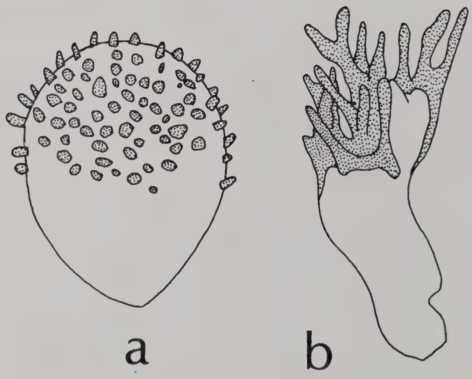

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emergence from the substrate (non-insititious stipes, figs. 2c & 2d) are placed in *Collybia* section *Subfumosae.* Those with cuticles of interwoven, smooth or incrusted hyphae and non-insititious stipes belong to *Collybia* section *Vestipedes* or section *Laevipedes.* Species whose basidiocarps have diverticulate hyphae in the pileus cuticle but which lack specialized hairs at the point of emergence of the stipe (i.e., insititious stipes, figs. 2a & 2b) are placed in *Marasmiellus* Murrill emend. Singer 1962. *Micromphale* S. F. Gray includes species whose basidiocarps have cuticles of interwoven hyphae in a gelatinous matrix and black rhizomorphs present or not. North temperate species formerly placed in *Marasmius* may also be found in *Xeromphalina, Strobilurus, Mycena,* and *Crinipellis.* For the disposition of these species, see the key to temperate marasmioid genera and the appendix of the present work. For a discussion of related subtropical and tropical genera, see Singer (41).

Available keys to North American species of *Marasmius* are those of Pennington (25) and Kauffman (11). Keys to European species appear in treatments by Singer (33), Kühner and Romagnesi (16), and Moser (23). Singer's (32, 34, 35) type studies also contribute valuable information. Singer has recently monographed South American (36, 39) and Australian (40) Marasmii.

For a discussion of the nomenclatural status of *Marasmius* and of its sections, see Singer & Smith (42), Singer (33, 37) and Gilliam (7).

Figure 1. Explanation of terms denoting breadth of lamellae. a. Narrow, with the breadth less than 1/4 the pileus radius. b. Moderately broad, with the breadth about 1/4 the radius. c. Broad, with the breadth 1/3 or more the radius.

Figure 2. Insititious and non-insititious stipes. a, b. Insititious stipes. c,d. Non-insititious stipes. Note the presence of specialized hairs at the juncture of stipe and substrate.

Figure 3. Plicate and striate pilei. a. Plicate pileus. b. Striate pileus.

Figure 4. Broom cells. a. Type of broom cell usually found in *Marasmius* sections *Marasmius* and *Hygrometrici.* b. Type of broom cell usually found in *Marasmius* section *Sicci.*

SECTIONAL CONCEPTS

Sectional concepts in current use are those of Kühner (14) as modified by Kühner and Romagnesi (16) and by Singer (37). Sections of *Marasmius* with species occurring in the northeastern United States and adjacent Canada are *Androsacei* Kühner, *Epiphylli* Kühner, *Globulares* Kühner, *Chordales* Fries (= *Alliacei* Kühner), *Sicci* Singer, *Hygrometrici* Kühner, and *Marasmius* (= *Rotulae* Kühner).

A species of *Marasmius* is placed in section *Androsacei* if the basidiocarps have black rhizomorphs, insititious stipes, and diverticulate or rarely smooth, interwoven hyphae in the pileus cuticle. Rhizomorphs of *Marasmii*, as distinguished from sterile stipes and pseudorhizae, are narrow, often branched, threads which arise from the litter on which the basidiocarps are growing and may bind debris. In *Marasmius* they are always black. Sterile stipes also arise from the substrate and extend into the air but have the same diameter as the fertile stipes and are about the same length. Pseudorhizae, which are not present in the *Androsacei* but may occur in other sections, are rootlike extensions of the stipe below ground level. Diverticulate hyphae are not the equivalent of diverticulate hyphal end cells in the descriptions: only the terminal hyphal cell has diverticula in the latter case, whereas diverticulate hyphae have many such cells.

Kühner includes in *Marasmius* section *Epiphylli* species whose pilei have hymeniform cuticles of smooth cells and sometimes also short, hyaline cystidia; whose stipes are insititious; and whose trama is nonamyloid. Species in this section usually have basidiocarps whose pilei are less than five mm broad, are usually pale in color, and grow on leaves or twigs. In the present work, the term "smooth cell" is used whenever the cell type involved almost always lacks diverticula or appendages. If one or a few diverticula are occasionally present, the term is still used in a general sense but is then qualified in the description.

Marasmius section *Globulares* Kühner includes species whose pilei have hymeniform cuticles of smooth cells, whose trama is dextrinoid, and whose stipes are non-insititious. Pilei of these species are larger than in the previous section (up to about 65 mm broad).

Species placed in *Marasmius* section *Chordales* Fries have pilei with hymeniform cuticles of smooth cells (or cells with a few rounded nodules) and stipes which are non-insititious. The trama is nonamyloid, and the pilei are usually more than five mm broad. This section has been treated separately (7).

Singer described *Marasmius* section *Sicci* for species whose basidiocarps have dextrinoid trama, non-insititious stipes, and hymeniform cuticles of cylindric to clavate broom cells with rodlike projections (fig. 4b). Setae may also be present. Species in this section often have plicate pilei (fig. 3a). The lamellae are adnate to the stipe or almost free.

Characters which, in combination, define *Marasmius* section *Marasmius* are nonamyloid trama, a hymeniform pileus cuticle composed of broom cells ornamented with numerous warts (fig. 4a), and black rhizomorphs. The lamellae are adnate to a collar surrounding the stipe. A collar arises when tissue from the pileus and lamellae is elaborated at the juncture of pileus and stipe. In the present work, if the tissue joins two or more, but not all, the lamellae and remains united with the stipe, the collar is termed partial and adnate. If complete but not free from the stipe, the collar is called a complete, adnate collar. If free from the stipe and also complete, as is usually the case in section *Marasmius*, the collar is called complete and free.

Marasmius section *Hygrometrici* is similar to section *Marasmius* in including species whose pilei have nonamyloid trama and hymeniform cuticles of obovate broom cells with wart-like projections. Species in this section, however, lack black rhizomorphs, and the lamellae are adnate to the stipe or to a partial, adnate collar rather than to a complete, free collar.

DIAGNOSTIC CHARACTERS OF SPECIES

This section will not attempt to discuss the entire range of variation present in all characters but will rather discuss the basis of characters which are critical in diagnosis, using more detail than is possible in the individual species descriptions. Singer (39) has published an excellent review of diagnostic characters in *Marasmius* which includes a discussion of many features not mentioned here.

Color may vary considerably within a species but usually remains within a single hue (e.g., yellowish brown) and varies in shade and intensity. Color should be noted for the pileus, the lamellae, the stipe, and rhizomorphs if present. Often the disc of the pileus is darker than the margin, and younger basidiocarps darker than old ones. Since the pigment is not cytoplasmic or vacuolar but resides in the walls of the cuticular cells, color does not usually change markedly with variation in the amount of moisture except in the few species with moderately thick trama.

The degree of striation or folding of the pileus surface often serves as a useful character in diagnosis of species. If faint lines are visible on the pileus above the lamellae (fig. 3b), the pileus is described as striate. "Rugulose-striate" has been used in the descriptions as a designation of texture in combination with striation, referring to a condition in which the pileus surface is rugulose directly over the lamellae but not elsewhere. If there are radial folds above the lamellae, the condition is called sulcate (if the folds are shallow to moderately deep) or plicate (if the folds are deep) (fig. 3a).

Vesture, since it reflects the type of cuticle present, may often be diagnostic and should be examined with at least a 10X lens. Vesture is most likely to be present on the disc. Here, as elsewhere when the term "minutely" is used, it means that the character was visible only with such a lens.

In studying Marasmii odor and taste should be carefully recorded. Some odors are detectable only in moist, crushed pilei. Garlic and onion odors are those most likely to be species-specific. These latter odors may be weak to strong or even absent in a given specimen, but can usually be found in at least some basidiocarps of even dried herbarium specimens. A wide variety of other odors and tastes may be encountered, but these are not usually valuable in distinguishing species reliably.

The breadth of lamellae provides one of the most useful diagnostic characters in *Marasmius*. Figure 1 illustrates the meanings of narrow, moderately broad, and broad lamellae as used in the present work. Spacing of the lamellae may be defined arbitrarily for *Marasmius* in terms of the number of mm between lamellae (including lamellulae which reach halfway or more to the stipe) at the edge of a pileus about 20 mm broad. A pileus with crowded lamellae has less than 1 mm between lamellae; one with close lamellae has about 1 mm between lamellae; one with distant lamellae, about 3 mm between lamellae; and one with remote lamellae, 4 or more mm between lamellae. The number of lamellae per basidiocarp, especially in species with few lamellae, may be useful, as may the equality or inequality of the lamellae. Irregularities in color, such as blotches of a different color, marginate edges, or dark dots on the lamellar faces, are almost always significant.

In separating species, the two most important characters of the stipe are consistency and vesture. Consistency has been used in the classification of *Marasmius* since the time of Fries and requires some experience to interpret. In general, stipes termed "delicate" in the present work are thin and very flexible, although they do not collapse on loss of moisture as would the stipe of a *Mycena*. Cartilaginous stipes have approximately the consistency of cartilage and are tough but relatively flexible. Broomstraw-like stipes are thin and flexible but tough, while stipes described as wiry or horny are very stiff and relatively inflexible. Descriptions of Marasmii should note the location and extent of the stipe vesture, color changes with time, and the characteristics of the hairs. Use of a 10X lens is necessary.

Since spore prints of Marasmii are difficult to obtain, their colors have not been much used in the taxonomy of the genus. In most cases the spore print is white, but pale orange yellow to dark orange yellow prints have been noted. More data are needed before the significance of such variation may be evaluated.

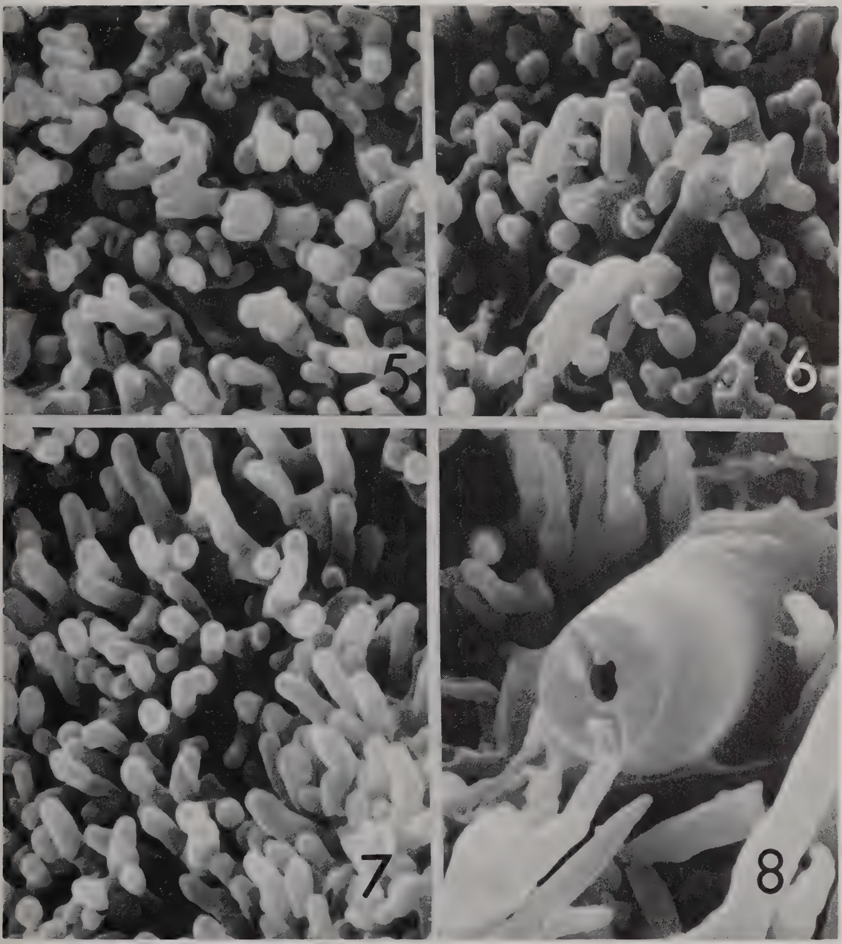
As discussed by Singer (39), spore size varies widely within species of *Marasmius*, particularly in species with large spores. Ranges of spore size, therefore, are of only limited value in distinguishing species, except in species with extremely small spores. There do exist differences in mean spore size, however, that are more meaningful. Although this was not recognized in time to collect data accordingly, the use of mean spore size provides the most diagnostic spore measurement. Length-to-width ratio and shape are also valuable.

Broom cells (fig. 4) and leptocystidia (e.g., fig.14b) on the lamellar edges and faces provide useful diagnostic information with respect to their presence or absence, size and shape, pigmentation, and the configuration of projections if present. The terms "pleurocystidia" and "cheilocystidia" are confusing when used for *Marasmius*. Leptocystidia occupy both the faces and edges of the lamellae with no differences in morphology between cells in the two locations. Broom cells usually occur on the edges only. If both broom cells and leptocystidia occupy the lamellar edge, the use of the term "cheilocystidia" for both is confusing. Setae, if present, may occur on both the lamellar edges and faces. If the terms "cheilocystidia" and "pleurocystidia" are used for them, two identical descriptions of the same cell type must be used. Cells are called hymenial cystidia in the present work if they have specialized (e.g., capitate, acute, or moniliform) apices or if they project beyond the basidioles and have hyaline walls up to 1 µm thick. Broom cells and hymenial setae are described as such, and their location is specified.

Clamp connections are present on most hyphae of the basidiocarp in all species of *Marasmius* occurring in the geographical area under consideration. This feature is of some importance in the differentiation of subtropical and tropical species but has not been found to be so here.

Many diagnostic characters may be found by examining the structure of the pileus cuticle. The arrangement of the component cells or hyphae, their size and shape, their color as mounted in water and in Melzer's reagent, and the size and shape of projections from the cells offer dependable criteria for identification of species. The term "cuticle" is used to denote the covering layer of the pileus in its entirety, following Singer (38) and Shaffer (31). If there is differentiation into two layers, the upper layer is termed the epicutis and the lower, the subcutis.

The appearance of broom cells on the pileus surface may, upon comparison, aid in separating species. Scanning electron micrographs (figs. 5-8) were instructive in detecting differences, which could then be more clearly seen with the compound microscope. Broom cells vary in uniformity of wall thickness, in diameter of the projections, and in length of projections. Radial scans of pilei revealed cells with nodules or projections on the disc and edges of the pilei in species which had formerly been described



Figures 5-8. Scanning electron micrographs of the pileus surface, x6000 (courtesy of Larry Allard).

Figure 5. *Marasmius borealis*, Gilliam 1171.

Figure 6. *Marasmius bellipes*, Mazzer 6626.

Figure 7. *Marasmius siccus*, Gilliam 869.

Figure 8. *Marasmius cohaerens* var. *lachnophyllus*, Ammirati 2477. The large structure in the center is a seta.

as having only smooth cells in the cuticle.

The microscopic appearance of the stipe vesture is often sufficiently distinct to permit recognition of certain species by virtue of that feature alone. In section *Sicci* the features of broom cells, if present, at the apex of the stipe may be diagnostic. The configuration of the outer walls of the cortical hyphae, of the broom cells, or of the hairs, may also be important.

ACKNOWLEDGMENTS

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TAXONOMY

MARASMIUS Fries, Fl. Scan. 339. 1835, nom. cons., emend. Singer, Mycologia 50: 103. 1958.

Androsaceus Patouillard, Hymen. Eur. 105. 1887. Type species: *Androsaceus rotula* (Scopoli ex Fries) Patouillard, Hymen. Eur. 105. 1887.

Chamaeceras Rebentisch ex Kuntze, Rev. Gen. Pl. III,2: 454. 1898. Type species: *Chamaeceras androsaceus* (Fries) Kuntze, Rev. Gen. Pl. III, 2: 454. 1898.

Mycenitis Earle, Bull. New York Bot. Gard. 5: 414. 1909. Type species: *Mycenitis alliaceus* (Fries) Earle, Bull. New York Bot. Gard. 5: 414. 1909.

Scorteus Earle, Bull. New York Bot. Gard. 5: 415. 1909. Type species: *Scorteus oreades* (Bolton ex Fries) Earle, Bull. New York Bot. Gard. 5: 415. 1909.

Type species: *Marasmius rotula* (Scopoli ex Fries) Fries, Epicr. Myc. 385. 1838.

Pileus small to moderately large (1-65 mm broad), convex, squarely pulvinate, or campanulate and sometimes papillate, umbonate, or depressed, often striate or sulcate, usually thin, usually tough and reviving, glabrous or minutely velutinous. Odor and taste lacking, or foetid, spermatic, or of garlic or onions. Lamellae narrow to broad or sometimes veinlike, thin, few, or rarely numerous, remote to crowded, adnate to free or adnate to a partial or complete collar. Stipe central or somewhat eccentric (sometimes lacking in subtropical or tropical species), thin, equal or tapered to the apex or base, bristle-like, broomstraw-like, cartilaginous, pliant, or horny, glabrous or pubescent to strigose, insititious or with a tuftlike basal mycelium, sometimes with a short pseudorhiza. Rhizomorphs or sterile stipes sometimes present, black.

Spores white or rarely pale orange yellow in mass, clavate, cylindric, obovate, or pip-shaped, hyaline, smooth, nonamyloid, not metachromatic. Basidia clavate to subclavate, 4- or rarely 2-spored, clamped, nonamyloid. Basidioles subclavate or subfusiform to fusiform. Hymenial cystidia often present, clavate, cylindric, or fusoid-ventricose, capitate, capitellate, submoniliform, short-appendiculate, or sometimes rounded to acute apically, hyaline to pale orange yellow. Hymenial setae sometimes present. Hymenial broom cells often present on the lamellar edges, similar to the cuticular broom cells. Lamellar trama of parallel to interwoven, septate, branched, nonamyloid or dextrinoid connective hyphae. Clamp connections usually present. Pileus trama of interwoven, often inflated hyphae otherwise similar to those of the lamellar trama. Pileus subcutis rarely present, but if delimited, not of inflated cells. Pileus cuticle or epicutis a hymeniform layer of smooth cells, diverticulate cells, or broom cells and sometimes occasional setae or short cystidia, or a dense layer of interwoven, diverticulate or rarely smooth hyphae (and then black rhizomorphs present and the stipe insititious). Stipe usually corticated thinly, the cortical hyphae dark in color and thick-walled. Stipe vesture, if present, of broom cells, cystidia, or thin- to thick-walled hairs. On fallen leaves, wood, humus, or grasses, or rarely on living trees.

The following key is based in part on Singer's (37-39, 41) classification. Taxa included are those formerly placed in *Marasmius* sensu Fries as well as the sections of *Marasmius* treated here. Related tropical and subtropical taxa do not appear in the key.

KEY TO SECTIONS OF MARASMIUS AND OTHER NORTH TEMPERATE TAXA CONTAINING MARASMIOID SPECIES

1. Spores amyloid
   2. Basal mycelium yellow to brownish orange; pileus subcutis, if present, not pseudoparenchymatous ....*Xeromphalina*
   2. Basal mycelium, if present, usually white or gray, but not yellow or brownish orange; pileus subcutis often pseudoparenchymatous if present........*Mycena*
1. Spores nonamyloid
   3. Pileus cuticle with long dextrinoid hairs.......... ....*Crinipellis*
   3. Pileus cuticle lacking long dextrinoid hairs, but sometimes with short nonamyloid filaments or cystidia
      4. Cuticle of unexpanded pilei composed of interwoven hyphae; black rhizomorphs absent
         5. Cuticular hyphae weakly to strongly diverticulate
            6. Stipe insititious; cuticular hyphae diverticulate from the beginning .... *Marasmiellus* emend. Singer 1962
            6. Stipe not insititious (with mycelium

visible at the point of emergence); cuticular hyphae smooth at first, diverticulate only in age; black rhizomorphs absent........ *Collybia* sect. *Subfumosae*

5. Cuticular hyphae smooth or occasionally lobed or incrusted

7. Pileus cuticle embedded in a gelatinous matrix.......................*Micromphale*

7. Pileus cuticle lacking gelatinous layers

8. Stipe pubescent or tomentose overall.......*Collybia* sect. *Vestipedes*

8. Stipe glabrous except at the base ....*Collybia* sect. *Laevipedes*

4. Cuticle of unexpanded pilei a hymeniform layer of smooth or diverticulate hyphal end cells or broom cells, or, if composed of interwoven smooth or diverticulate hyphae, then black rhizomorphs also present

9. Pileus cuticle a dense layer of interwoven diverticulate or rarely smooth or spirally incrusted hyphae; stipe insititious; black rhizomorphs present.......................... ....*Marasmius* sect. *Androsacei*

9. Pileus cuticle a hymeniform layer of smooth or diverticulate hyphal end cells or broom cells; stipe insititious or not; black rhizomorphs present or absent

10. Growing from cones; clamp connections consistently absent.................... .....*Strobilurus* (marasmioid species)

10. Growing from other substrates; clamp connections present in all north temperate species examined

11. Cells of the pileus cuticle usually smooth, if diverticulate or with a few hyaline nodulose projections, then the trama nonamyloid and black rhizomorphs absent

12. Pileus or lamellar trama or both dextrinoid............ ..*Marasmius* sect. *Globulares*

12. Pileus and lamellar trama nonamyloid

13. Pileus white, pale pink or pale orange yellow, less than 5(-8) mm broad

at maturity; lamellae usually poorly developed .... *Marasmius* sect. *Epiphylli*

13. Pileus usually darker, more than 5 mm broad at maturity; lamellae well developed........*Marasmius* sect. *Chordales* (7)

11. Cells of the pileus cuticle ornamented, at least in young pilei, with numerous warts or rodlike projections; trama dextrinoid, or if nonamyloid, then black rhizomorphs present or the warts on the cuticular cells moderate brown

14. Cuticular broom cells usually subglobose to sphaeropedunculate and ornamented with warts (fig. 4a); trama nonamyloid

15. Lamellae adnate to a complete, free collar or rarely a partial, adnate collar; cystidia absent; black rhizomorphs present.................*Marasmius* sect. *Marasmius*

15. Lamellae adnate or adnexed to the stipe or rarely adnate to a partial, adnate collar; cystidia present on the lamellae and sometimes on the pileus cuticle; black rhizomorphs absent ....*Marasmius* sect. *Hygrometrici*

14. Cuticular broom cells usually clavate to cylindric and ornamented with rodlike or finely divided projections (fig. 4b); trama dextrinoid ....*Marasmius* sect. *Sicci*

KEY TO MARASMIUS SECTION ANDROSACEI

1. Pileus minute (1-3 mm broad); odor of crushed pilei in fresh and dried, remoistened specimens of garlic...1. *Marasmius thujinus*
1. Pileus small but not minute (2-20 mm broad); odor of crushed pilei mild or absent
    2. Diverticulate cells not present in the hymenium; pileus light yellowish brown to yellowish white with the disc dark brown or moderate brown; hyphal walls of the stipe cortex irregularly incrusted or spirally thickened.....2. *Marasmius pallidocephalus*
    2. Diverticulate cells present on the lamellar edges, clavate, with 3-20 hyaline diverticula; pileus dark brown to light brown, sometimes fading in age to light yellowish brown; hyphal walls of the stipe cortex smooth or rarely somewhat incrusted, but not spirally thickened.........3. *Marasmius androsaceus*

KEY TO MARASMIUS SECTION EPIPHYLLI

1. Pileus cuticle a hymeniform layer of thick-walled cells with 1-5 broad, often incrusted, conic projections; on fallen beech leaves...............4. *Marasmius epifagus*
1. Pileus cuticle a hymeniform layer of thin- to thick-walled smooth cells; on leaves of various herbaceous and woody plants, but not on beech leaves
    2. Pileus light yellowish pink; on leaves of herbaceous dicots..........................5. *Marasmius felix*
    2. Pileus white to yellowish white; on leaves of monocots or woody dicots
        3. On culms of *Carex*.......6. *Marasmius caricicola*
        3. On leaves of woody dicots, particularly Betulaceae...................7. *Marasmius epiphyllus*

KEY TO MARASMIUS SECTION GLOBULARES

1. Hymenial cystidia or setae lacking; growing in grass or rarely under spruce, often in fairy rings...8. *Marasmius oreades*
1. Hymenial cystidia or setae present; growing on humus in deciduous woods, not in fairy rings
    2. Hymenial setae hyaline...11. *Marasmius delectans* (sect. *Sicci*)
    2. Hymenial setae absent
        3. Hymenial cystidia present on the lamellar faces and usually on the edges as well; stipe

vesture lacking........9. *Marasmius cystidiosus*
3. Hymenial cystidia present on the lamellar edges only; stipe vesture of hyaline hairs 4-7 µm broad.................10. *Marasmius strictipes*

KEY TO MARASMIUS SECTION SICCI

1. Hymenial setae present
   2. Pileus yellowish white; setae hyaline in water or 2% KOH, often with capitate or rounded apices...11. *Marasmius delectans*
   2. Pileus some shade of brown; setae light yellowish brown to moderate brown in water or 2% KOH, usually with acute apices
      3. Lamellae no broader than 1/4 the pileus radius, close (at least 1/mm at the pileus edge); stipe setae usually abundant.............................13. *Marasmius cohaerens* var. *lachnophyllus*
      3. Lamellae broader than 1/4 the pileus radius; distant to remote (<1/mm at the pileus edge); stipe setae rare......................................12. *Marasmius cohaerens* var. *cohaerens*
1. Hymenial setae absent
   4. Stipe covered overall with broom cells and branched or unbranched hairs
      5. Lamellae crowded (at least 10/mm at the pileus edge); stipe >2 mm thick..16. *Marasmius spissus*
      5. Lamellae remote to close (fewer than 10/mm at the pileus edge) or, if crowded, then the stipe <2 mm thick
         6. Pileus 6-25 mm broad, brilliant orange to strong brown or moderate reddish orange, often with minute yellow spots on the margin when dried........14. *Marasmius sullivantii*
         6. Pileus 2-6 mm broad, moderate orange or paler..............15. *Marasmius armeniacus*
   4. Stipe glabrous above the basal mycelial pad or with broom cells only at the extreme apex or base
      7. Lamellae crowded (at least 10/mm at the pileus edge)....................16. *Marasmius spissus*
      7. Lamellae remote to close (<1/mm at the pileus edge)
         8. Sterile stipes present; usually on Gramineae ...26. *Marasmius graminum* (sect. *Marasmius*)
         8. Sterile stipes absent; on woody or herbaceous debris, but only rarely on Gramineae

9. All cuticular broom cells on a single pileus uniformly either thin-walled or thick-walled, with the projections either narrow (0.5-1 µm) on all cells or broad (1-2.2 µm) on all cells

    10. Pileus remaining even (nonstriate and nonsulcate) throughout development

        11. Projections of cuticular broom cells 2.8-5.6 X 0.5-1.5 µm; spores 13-17 µm long.................17. *Marasmius borealis*

        11. Projections of cuticular broom cells 7-14 X 1-2.2 µm; spores 7-10.8 µm long.......................18. *Marasmius spadiceus*

    10. Pileus soon either striate or sulcate

        12. Hymenial cystidia refractive and usually pale yellow, often arising deep in the trama and curved at the base; pileus 2.5-27 mm broad............................19. *Marasmius siccus*

        12. Hymenial cystidia, if present, hyaline, nonrefractive, rare, and inconspicuous, arising at the same level as the basidioles and not curved at the base; pileus 19-45 mm broad.........18. *Marasmius fulvoferrugineus*

9. Cuticular broom cells on a single pileus both thick-walled and thin-walled (e.g., fig. 38), with the thicker-walled cells inset or spaced evenly at intervals and the projections narrow (0.5-1.5 µm broad) on some cells and broad (1-2.5 µm broad) on others

    13. Spores 2-2.5 times longer than broad; lamellae broad in age; pileus moderate brown or moderate yellowish brown at first..........................21. *Marasmius glabellus*

    13. Spores at least 2.6 times longer than broad; lamellae narrow to moderately broad in age; pileus pink,

purplish pink, light yellowish brown, or moderate yellowish pink at first

- 14. Spores 9-13 μm long; cuticle not appearing mottled in a regular pattern on low magnification..22. *Marasmius bellipes*
- 14. Spores 11-16 μm long; cuticle (surface view) appearing mottled in a regular pattern on low magnification
  - 15. Lamellae 16-23; pileus campanulate at first; projections of cuticular broom cells up to 2 μm broad; stipe apex purplish pink to light yellowish brown at first... 23.*Marasmius pulcherripes*
  - 15. Lamellae 11-16; pileus convex at first; projections on cuticular broom cells up to 1(-1.5) μm thick; stipe apex white or light yellow at first. .24. *Marasmius robinianus*

MARASMIUS SECTION HYGROMETRICI

Only a single species occurs in the region under consideration: 25. *Marasmius minutus.*

KEY TO MARASMIUS SECTION MARASMIUS

- 1. Pileus moderate orange to strong reddish brown or nearby, at least when young; cuticular broom cells with 2-25 unbranched, short, rodlike projections
  - 2. Stipe moderate reddish brown to blackish brown below, glabrous.............26. *Marasmius graminum*
  - 2. Stipe white overall, pubescent.27. *Marasmius olneii*
- 1. Pileus white to light yellowish brown or light brown at first; cuticular broom cells densely covered above with numerous warts or finely divided projections
  - 3. Cuticular broom cells with finely divided projections; spores 9-13 μm long..28. *Marasmius pruinatus*
  - 3. Cuticular broom cells ornamented with closely spaced warts; spores 6-11 μm long

4. Stipe less than 0.3 mm thick; pileus obtusely conic, often abruptly paler on the disc; usually on oak leaves...........29. *Marasmius capillaris*
4. Stipe more than 0.3 mm thick; pileus pulvinate, then convex-depressed, not markedly paler on the disc; on decaying hardwood logs or debris..30. *Marasmius rotula*

MARASMIUS section ANDROSACEI Kühner, Botaniste 25: 91. 1933.
Marasmius I Insititii I Setipedes a Foliicolae Quélet, Fl. Mycol. France 311. 1888.
Marasmius C Rotulina Patouillard, Ess. Taxon. 145. 1900.
Type species: *Marasmius androsaceus* (Linnaeus ex Fries) Fries, Epicr. Myc. 385. 1838.

Pileus small (<20 mm broad), smooth or radially rugulose, thin, tough, light or dark in color. Odor and taste mild, foetid, or of garlic or onions. Lamellae thin, few, close to distant, adnate to adnexed, or attached to a partial, adnate collar. Stipe thin, bristle-like, cartilaginous, or firm and filiform, glabrous or rarely pubescent, insititious. Rhizomorphs numerous, black. Sterile stipes and basal mycelium absent.

Spores elliptic to narrowly obovate or pip-shaped. Diverticulate cells sometimes present on the lamellar edges. Trama of pileus and lamellae nonamyloid or dextrinoid. Pileus cuticle of interwoven, diverticulate or rarely smooth hyphae. Stipe cortex of smooth or roughened hyphae, lacking vesture or with thick-walled hairs.

On needles of coniferous trees or rarely on leaves of deciduous trees.

1. MARASMIUS THUJINUS Peck, New York State Mus. Bull. 67: 26. 1902 (1903). FIG. 9
Marasmius piceina Kauffman, Pap. Michigan Acad. Sci. 1: 143. 1921 (1923).

PILEUS 1-3 mm broad; pulvinate at first, becoming convex and sometimes shallowly depressed or umbilicate; dry; dull; opaque; at first smooth; soon minutely rugulose; often faintly sulcate-striate to the disc; entire or lobed; membranous and rather tough; reviving. CUTICLE minutely velutinous; brownish pink centrally, light yellowish pink (Pinkish Buff) on the margin, in dried specimens pale yellow or brownish pink. TRAMA thin; white or nearly so. ODOR of crushed pilei of garlic. TASTE tardily of garlic.

LAMELLAE moderately broad (up to 1 mm broad on a pileus 2 mm across); thin; distant; few (8-10 reach the stipe); equal at first, soon with short lamellulae alternating with the lamellae; adnate at first, then adnexed to deeply emarginate; pliant; entire; at first straight, then broadest near the edge; not intervenose; not forked; nearly white, drying pale yellow.

STIPE 12-25 mm long, 0.1-0.2 mm thick; terete; filiform; straight, but curled upon drying; dry; shining; translucent; solid; firm; even; glabrous or minutely pruinose, particularly near the base; yellowish white at the apex, light yellowish brown tinged red below, rarely dark brown at the base; insititious. STERILE STIPES lacking. RHIZOMORPHS rare to abundant, often binding several needles; capillary (less than 0.1 mm broad); short (less than 10 mm long); curled; dark brown. BASAL MYCELIUM lacking.

SPORES (7.0-)8.0-11.2 X 2.5-4.2 µm; pip-shaped or narrowly fusoid-elliptic. BASIDIA 18-32 X 5.5-8.5 µm; clavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA absent.

TRAMAL HYPHAE of pileus and lamellae 1-4 µm broad; interwoven; hyaline to light grayish yellow or rarely light yellowish brown; with hyaline, thin walls; nonamyloid.

PILEUS CUTICLE an uneven layer of interwoven diverticulate hyphae. CUTICULAR HYPHAE up to 7 µm broad; thin-walled near the pileus margin, with light yellowish brown, unevenly or spirally thickened walls up to 1.5 µm thick on the disc; regularly and closely knobbed-diverticulate, the diverticula short and broad (2-5 X 2-4 µm), often blunt, refractive, and hyaline to pale yellow or light yellowish brown; with short branches which are occasionally clavate and erect.

STIPE corticated overall. CORTICAL HYPHAE 2-4 µm broad; with thin hyaline to light yellowish brown walls which are regularly and evenly short-diverticulate along the outer surface and smooth on the inner; nonamyloid. TRAMAL HYPHAE 6-8 µm broad; with thin hyaline to pale yellow walls; nonamyloid.

Gregarious and sometimes in troops on needles of

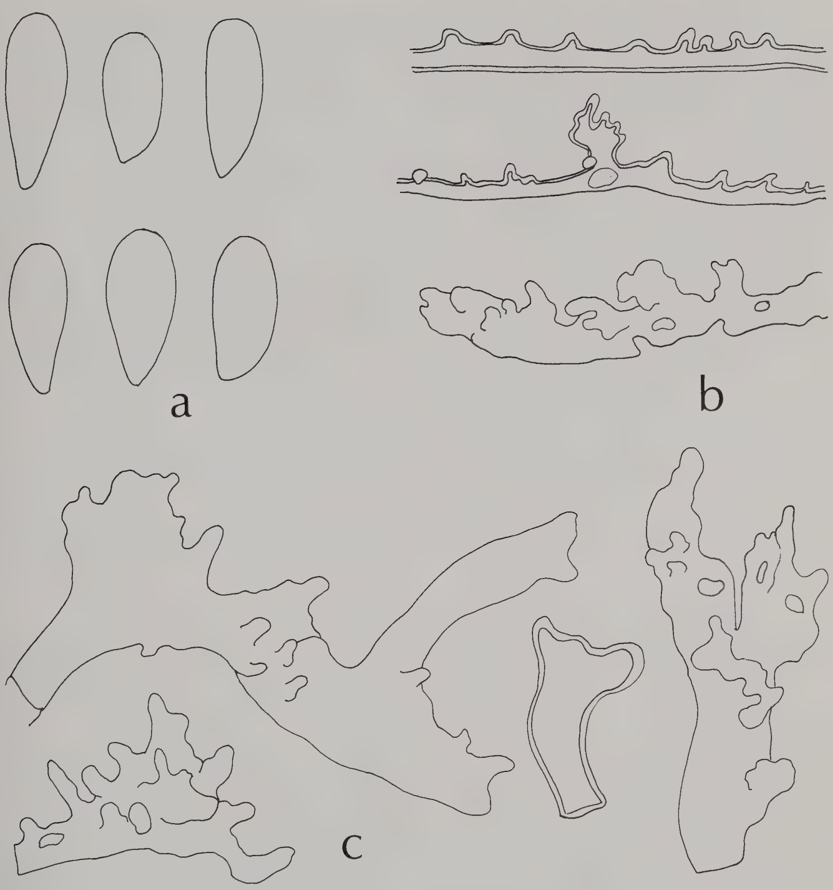


Figure 9. *Marasmius thujinus*, Gilliam 1459. a. Spores, x2300. b. Cortical hyphae of the stipe, x1500. c. Cuticular cells, x2300.

spruce, fir, and white cedar in coniferous woods. Fruiting period: 8 Sep-14 Oct (-8 Dec, Idaho).

Collections examined:

CANADA: BRITISH COLUMBIA: Harrison 6340. ONTARIO:

Smith 4745. UNITED STATES: COLORADO: Kauffman, 8 Sep (holotype of *Marasmius piceina* Kauffman). IDAHO: Cooke 19049. MICHIGAN: Smith 43798 & 63286; Gilliam 1459. NEW YORK: Peck, 19 Sep 1902 (holotype of *M. thujinus* Peck, NYS).

Although Peck's description of *Marasmius thujinus* does not mention the garlic or onion odor stated by Kauffman as occurring in *M. piceina*, the type specimens of *M. thujinus* when remoistened and crushed do give off a distinct odor of garlic. Since the garlic odor of fresh specimens may be missed if the pileus is not crushed, Peck's omission of the odor is understandable. Microscopic features of the type specimens of *M. thujinus* and *M. piceina* are similar. The difference in substrate appears to be unimportant, since Smith 63286 was found growing on needles of both *Picea* and *Thuja*. On the basis of the preceding evidence I consider *M. piceina* a synonym of *M. thujinus*.

2. MARASMIUS PALLIDOCEPHALUS Gilliam, Mycologia 67: 818. *f. 1-3.* 1975. FIG. 10

PILEUS 2-14 mm broad; pulvinate to convex at first, then plano-convex or broadly conic-convex, finally plane to shallowly concave and often subumbonate or umbilicate; dry, or subviscid in wet weather; matte, but shining when wet; opaque; smooth; even or faintly rugulose-striate up to 2/3 the pileus radius; at first entire, soon eroded or crenate; pliant or membranous; reviving. CUTICLE minutely velutinous or matted-fibrillose; dark brown in primordia, soon light yellowish brown, light grayish yellowish brown, light pinkish yellowish brown, light yellowish pink (Light Pinkish Cinnamon), pale orange yellow (Pale Pinkish Buff), or yellowish white (M&P 9B2) on the margin and darker [pale orange yellow (Pale Pinkish Buff), light yellowish brown (Cinnamon), dark brown (M&P 16A12), or moderate yellowish brown] on the disc. TRAMA thin (0.1-0.5 mm thick in the disc); yellowish white to light yellowish brown. ODOR and TASTE lacking.

LAMELLAE narrow (up to 1 mm broad); usually thin; subdistant to distant; moderately numerous (12-20 reach the stipe); unequal, with 1 or 2 irregular tiers of lamellulae; adnate at first, becoming adnexed to sinuate in age, or sometimes attached to a partial, adnate collar; pliant; entire or minutely fimbriate; straight at first, broader near the stipe in age; not intervenose or obscurely so in age; not forked; yellowish white, pale orange yellow

(Light Buff), or light yellowish brown.

STIPE 12-43 mm long, 0.2-0.8 mm broad; central or somewhat eccentric; terete; equal; straight when moist, soon curling and twisting in dry air; dry; shining; opaque; hollow; bristle-like but not tough (thin, stiff, and easily cut); even; glabrous or sometimes whitish-pruinose up to 1 mm from the apex downward; light yellowish brown to moderate yellowish brown or dark reddish brown to dark brown on the upper half, blackish brown below; insititious. STERILE STIPES absent. RHIZOMORPHS scarce to abundant; arising at intervals along the substrate; much branched; threadlike; twisted and curled; often binding several needles together; black. BASAL MYCELIUM absent.

SPORES white in mass; 6.0-9.8 X 2.5-4.2 µm; narrowly elliptic, narrowly obovate, or pip-shaped. BASIDIA 20-33 X 4-7 µm; clavate or subclavate; 4-spored. BASIDIOLES subfusiform to subclavate.

HYMENIAL CYSTIDIA lacking.

TRAMAL HYPHAE interwoven and inflated up to 8 µm broad in the pileus; parallel, uninflated, and 2.5-6 µm broad in the lamellae; with hyaline to light grayish yellow walls up to 0.5 µm thick; nonamyloid.

PILEUS SUBCUTIS 15-75 µm thick, composed of interwoven to ascending-interwoven hyphae 2-9 µm broad, with hyaline to moderate yellowish brown, often spirally thickened or irregularly incrusted walls up to 0.5 µm thick, often with broad diverticula or short branches, nonamyloid. PILEUS EPICUTIS up to 40 µm thick, an interrupted or continuous hymeniform or subhymeniform layer of clavate or cylindric cells 4-40 X 4-10 µm with few to many diverticula up to 4 µm broad and thin hyaline walls.

STIPE corticated overall. CORTICAL HYPHAE 1-3.5 µm broad; with smooth, beaded, roughened, or spirally thickened grayish yellow to deep brown walls less than 0.5 µm thick; nonamyloid. TRAMAL HYPHAE up to 7 µm broad; with hyaline walls up to 0.5 µm thick, or with the wall completely occluding the lumen; nonamyloid or more usually dextrinoid, at least in part.

Gregarious and sometimes in troops on needles of conifers, particularly spruce, in coniferous woods. Fruiting period: 14 Jun-30 Oct.

Collections examined:

CANADA: QUEBEC: Bigelow 4885 (MASS). UNITED STATES: MAINE: Bigelow 3086 (MICH) & 10140 (MASS). MASSACHUSETTS: Bigelow 6682 (MASS) & 6838 (MASS). MICHIGAN: Ammirati 1616 & 3056; Gilliam 1110, 1165 (holotype of *Marasmius pallidocephalus* Gilliam), & 1170; Patrick 268; Shaffer 1291; Smith 25365, 36435, 51673, & 66360. MINNESOTA: Weaver 1621. NEW HAMPSHIRE: Bigelow 11683 (MASS) & 12357 (MASS). NEW YORK: Bigelow 5128 (MASS) & 5138 (MASS). NORTH CAROLINA: Harrison 10976.

Marasmius pallidocephalus Gilliam may be commonly found in the summer after moderately heavy rains in spruce and hemlock woods. For a comparison between this species and *M. androsaceus,* see the original publication (8).

3. MARASMIUS ANDROSACEUS (Linnaeus ex Fries) Fries, Epicr. Myc. 385. 1838. FIGS. 11-13

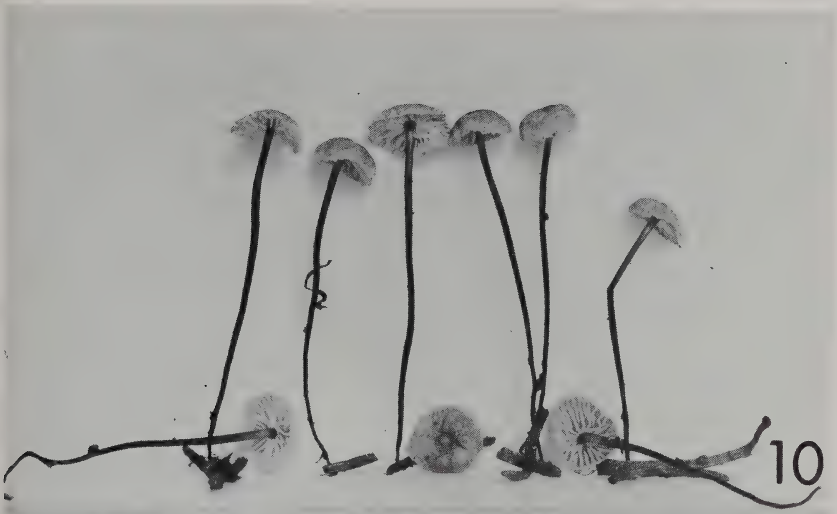
Agaricus androsaceus Linnaeus ex Fries, Syst. Myc. 1: 137. 1821.

Chamaeceras androsaceus (Linnaeus ex Fries) Kuntze, Rev. Gen. Pl. III, 2: 454. 1898.

Marasmius melanopus Morgan, J. Cincinnati Soc. Nat. Hist. 18: 36. *pl. 1, f. 2.* 1895.

PILEUS 2-15(-20) mm broad; convex or pulvinate at first with the margin incurved, becoming broadly convex to plano-convex and often depressed or umbilicate centrally, finally plane with the margin wavy and uplifted; dry; dull, or sometimes shining in wet weather; opaque, or sometimes translucent on the margin when wet; smooth at first, then minutely rugulose; at first even, becoming rugulose-striate or sulcate up to 7/8 the pileus radius; entire, eroded, or crenate; pliant; reviving. CUTICLE glabrous at mid-margin, often minutely granular-roughened on the disc and extreme margin; dark brown (M&P 8A10) or dark yellowish brown tinged pink when young and moist, then moderate brown (Army Brown, M&P 16A9-10), grayish reddish brown (M&P 15A8-9), or light brown (M&P 14A6), often dark brown (M&P 16A9-12) on the disc, rarely white on the extreme edge, in age or on drying sometimes fading to light yellowish brown (Wood Brown, Vinaceous-Cinnamon). TRAMA up to 1 mm thick, often indistinguishable; yellowish white to light yellowish brown. ODOR mild or lacking. TASTE lacking or rarely somewhat bitter.

LAMELLAE narrow (up to 1 mm broad); thin; subdistant to distant; few (10-20 reach the stipe); unequal, with 2-7 tiers of lamellulae; adnate, adnexed, or sometimes



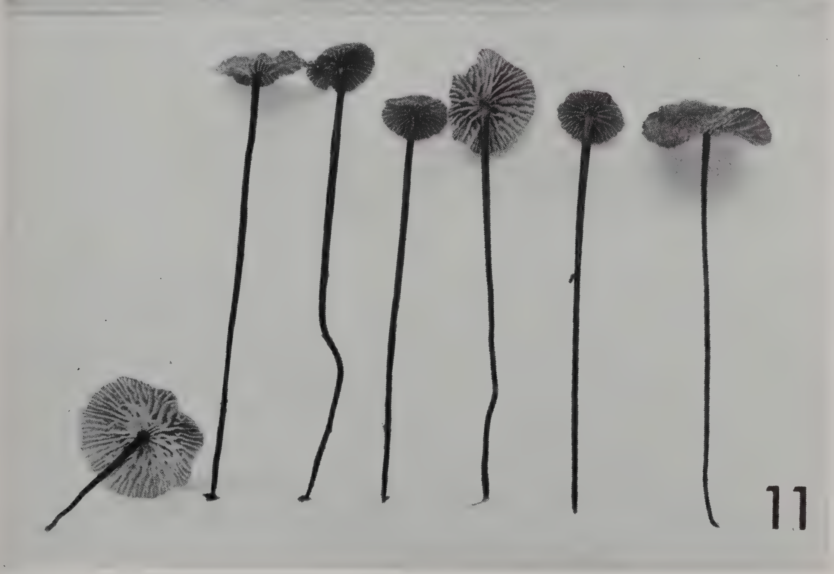


Figure 10. *Marasmius pallidocephalus*. Smith 51673, x1 (courtesy of A. H. Smith).

Figure 11. *Marasmius androsaceus*. Smith 62447, x1 (courtesy of A. H. Smith).

attached to a partial, adnate collar; tough-pliant; subfimbriate or minutely erose; at first straight, becoming subventricose in age; occasionally forked; yellowish white (M&P 11B5) at first, soon light grayish yellowish brown Avellaneous, M&P 12A6) or brownish pink, often tinged gray (M&P 12A2, 11A3) or grayish brown in age or when water-soaked.

STIPE 12-60 mm long, 0.2-1.1 mm thick; central; terete or flattened; equal or narrowed slightly to the base; straight or curved, often twisted; dry; dull or shining; opaque; hollow; wiry; glabrous, or with a few short barbs or slender branches; blackish brown to black overall or rarely moderate reddish brown or dark yellowish brown on the apical 1-2 mm; insititious. STERILE STIPES lacking. RHIZOMORPHS rare to abundant; 0.1-0.7 mm thick; arising from the substrate near the basidiocarps; often branched; bristle-like; twisted and coiled or recurved; glabrous or with fine barbs or tendrils which adhere closely to the substrate; blackish brown. BASAL MYCELIUM lacking.

SPORES white in mass; 6.7-8.8(-10) X 3.2-4.3 µm; elliptic, pip-shaped, or narrowly obovate. BASIDIA 19-34 X 4-7 µm; clavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL DIVERTICULATE CELLS 5.5-36 X 4-11 µm; usually clavate, sometimes obovate, subcylindric, or irregularly lobed; with 3-20 hyaline wartlike or rodlike diverticula 3-5(-11) X 0.5-3 µm which are rounded to acute and sometimes branched; with thin, hyaline walls; nonamyloid; rare to abundant on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated up to 11.5 µm in the pileus; parallel-interwoven, uninflated, and 2.5-7 µm broad in the lamellae; with hyaline to light grayish brown walls up to 0.5 µm thick; nonamyloid, but sometimes with granular dextrinoid contents.

PILEUS SUBCUTIS 10-60 µm thick, composed of interwoven hyphae 4-13.5 µm broad, with hyaline to moderate brown, often unevenly or spirally thickened walls up to 1.5 µm thick; dextrinoid; in age forming the uppermost layer of the pileus. PILEUS EPICUTIS a hymeniform layer 8-25 µm thick, of smooth or diverticulate cells 10-21 X 4-14 µm which are lobed, clavate, obovate, or cylindric and often pedicellate, smooth or with many hyaline diverticula 0.5-5 X 0.2-3 µm, and with hyaline walls up to 1 µm thick.

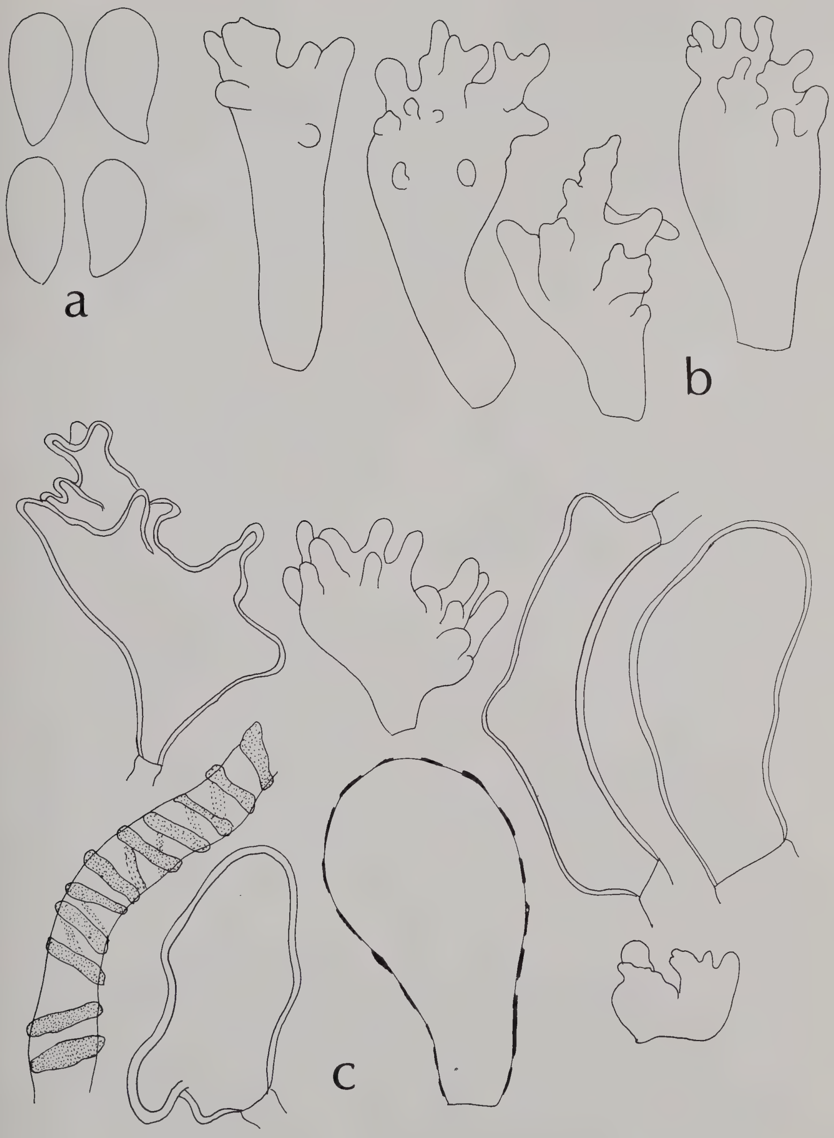


Figure 12. *Marasmius androsaceus*, Gilliam 1504, x2300. a. Spores. b. Diverticulate cells from the lamellar edge. c. Elements of the pileus cuticle.

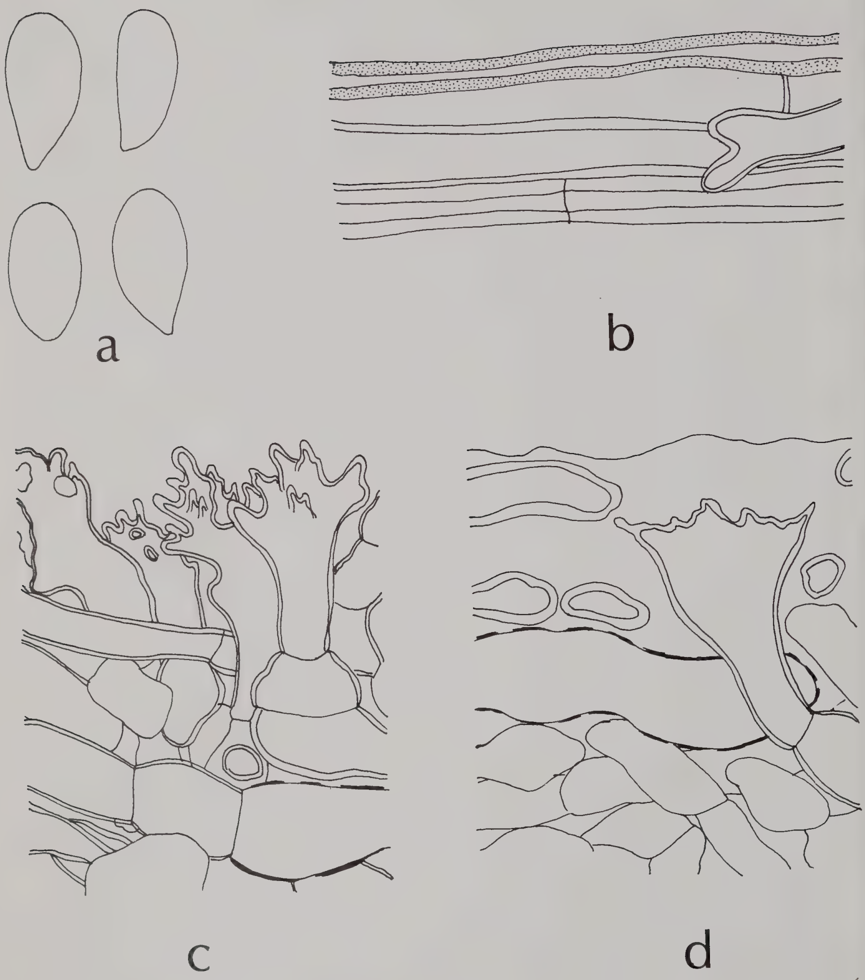


Figure 13. *Marasmius androsaceus*. a-b. Bigelow 3104. a. Spores, x2300. b. Section of stipe showing smooth cortical hyphae, x1500. c-d. Smith 62447, x2300. c. Tangential section of pileus cuticle taken from pileus edge. d. Tangential section of pileus cuticle taken halfway between the center and edge of the pileus.

STIPE corticated overall. CORTICAL HYPHAE 2.5-5.5 µm broad; with dark yellowish brown to blackish brown, often granular-roughened or unevenly incrusted walls up to 0.5-1 µm thick; nonamyloid or dextrinoid. STIPE VESTURE lacking.

Gregarious and often in troops on needles, cone scales, and debris of conifers, or rarely on deciduous leaves in coniferous or coniferous-deciduous woods. Fruiting period: 3 Jun-30 Oct.

Collections examined:

CANADA: NOVA SCOTIA: Smith 506. QUEBEC: Bigelow 4884 (MASS), 5427 (MASS) & 5723 (MASS). ENGLAND: SOMERSET: Smith 63164. FRANCE: HAUT-RHIN: Shaffer 4911. OISE: Shaffer 4647. GERMANY: Sydow, *Mycotheca Germanica* 301. SWITZERLAND: Favre, 29 Jun 1948. UNITED STATES: CALIFORNIA: Bonar 468. IDAHO: Smith 15805 & 58991. MAINE: Bigelow 3096 (MASS), 3104, 10053 (MASS), & 10208 (MASS). MASSACHUSETTS: Bigelow 6461 (MASS); Linder, Sep 1932 (FH). MICHIGAN: Gilliam 528, 529, 709, 778, 1166, 1172, 1239, 1455, & 1475; Patrick 226; Smith 33-405, 62447, 63434, & 72457; Weber 2569. MINNESOTA: Weaver 1194, 1958, & 2085. NEW JERSEY: Ellis, 20 Jul 1876 (NY). NEW YORK: Peck, Nov (FH); Gilliam 1284. NORTH CAROLINA: Harrison 10987, Hesler 10453 (FH). OHIO: Morgan, Preston, 1890 (holotype of *Marasmius melanopus* Morgan, IA); Gilliam 1504. OREGON: Smith 55757. VERMONT: Bigelow 14236 (MASS); Linder, 3 Jul 1938 (FH); Shaffer 3370. WASHINGTON: Smith 48818. WISCONSIN: Gilliam 1231. WYOMING: Solheim 5361.

Marasmius androsaceus is a Friesian name for which no holotype exists. After having examined numerous European collections, I am reasonably certain that the European and North American material belong to the same species and that the common taxon fits the Friesian description. For basidiocarps with light yellowish brown or pale orange yellow pilei and no diverticulate cells on the lamellar edges, see *M. pallidocephalus*.

Both large-spored (with spores 7-10 µm long) and small-spored (with spores 6.3-8.5 µm long) strains occur in *Marasmius androsaceus*. During the initial phases of my study of *M. androsaceus*, the presence of large spores seemed to correlate with a high frequency of diverticulate cells in the pileus cuticle, but this correlation soon broke down. The proportion of diverticulate cells in the pileus cuticle is at least partly a matter of age of the basidiocarp, since the diverticulate cells making up the epicutis become separated in age, leaving the interwoven hyphae of the subcutis to form the surface layer (fig. 13, c & d). Spore size ranges form a continuum if enough collections are studied.

A few collections (e.g., Weaver 1194) appear to have a gelatinous matrix present in the cuticular region, but this layer is actually composed of degenerate spores.

MARASMIUS section EPIPHYLLI ['Epiphylleae'] Kühner, Botan. 25: 93. 1933.
Type species: *Marasmius epiphyllus* (Persoon ex Fries) Fries, Epicr. Myc. 386. 1838.

Pileus minute to small (<5 mm broad), smooth becoming radially rugulose, thin, tough-membranous, white to pale orange yellow or pale yellowish pink. Odor and taste mild or lacking. Lamellae thick and veinlike, few or lacking altogether, distant to remote, adnate or attached to a partial, adnate collar. Stipe thin, pliant, minutely pruinose overall, insititious. Rhizomorphs lacking. Sterile stipes sometimes present. Basal mycelium lacking.

Spores obovate or fusoid-elliptic. Hymenial cystidia usually present, fusoid-ventricose, often capitate, hyaline. Trama of pileus and lamellae nonamyloid. Pileus cuticle a hymeniform layer of obovate or subglobose to cylindric thin- to thick-walled cells which are usually smooth but may have 1-5 broad conic projections, and sometimes occasional short cystidia. Stipe corticated thinly overall. Stipe vesture of thin- to thick-walled cystidioid hairs.

On leaves of dicotyledonous trees and herbs.

4. MARASMIUS EPIFAGUS Gilliam, Mycologia 67: 821. *f. 4-8*. 1975.

PILEUS 0.2-2 mm broad when dried; hemispheric at first, then convex to plano-convex; dry; dull; opaque at first, translucent in age; smooth; at first even, becoming distantly and obscurely rugulose-striate in age; entire; fragile. CUTICLE pruinose; pale yellow, moderate orange yellow, or light yellowish pink at first, fading in age to white or yellowish white. TRAMA not observed. ODOR and TASTE not observed.

LAMELLAE narrow and veinlike; thin or somewhat thickened; remote; few (1-7), or lacking altogether; equal; pruinose; adnate; entire; not intervenose; rarely forked; white.

STIPE up to 9 mm long, 0.1-0.2 mm thick; slightly eccentric; terete; filiform; dry; subshiny; delicate; even; densely whitish-pruinose; white overall at first, becoming moderate brown to deep brown from the base upward; insititious. STERILE STIPES lacking. RHIZOMORPHS lacking. BASAL MYCELIUM lacking.

SPORES 5.6-8.4 X 2.8-3.2(-3.8) µm; narrowly elliptic, subcylindric, or rarely obovate. BASIDIA 24-30 X 7-8.5 µm; clavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA 32-46 X 4.5-8.5 µm; fusoid-ventricose, sometimes with a constricted neck; with hyaline to pale yellow walls up to 1 µm thick; projecting up to 30 µm beyond the basidioles; nonamyloid; common on the edges and faces of the lamellae.

TRAMAL HYPHAE of the pileus and lamellae 1.5-5 µm broad; loosely interwoven; uninflated; with hyaline walls up to 1 µm thick; nonamyloid.

PILEUS CUTICLE a hymeniform layer of two types of cells: (1) THICK-WALLED CELLS (14-)25-30 X 5.5-7 µm, subcylindric to obovate, with 1-5 broadly conic or lobate, solid, hyaline to moderate orange yellow projections and hyaline to moderate orange yellow, unevenly incrusted or roughened walls up to 5 µm thick, nonamyloid but with granular dextrinoid contents; and (2) CYSTIDIA 25-35 X 5-7 µm, similar to the hymenial cystidia.

STIPE corticated in the pigmented portions only, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 2-4 µm broad; with moderate orange yellow to deep brown walls up to 1 µm thick; nonamyloid. TRAMAL HYPHAE 1.5-4 µm broad; with thin, hyaline walls; nonamyloid. CYSTIDIA up to 18 X 8.5 µm; cylindric, conic, or tapered; with hyaline to moderate orange yellow, sometimes incrusted walls up to 0.5 µm thick; abundant overall.

Gregarious on beech leaves in beech-maple woods. Fruiting period: 8 Sep-5 Oct.

Collections examined:

MASSACHUSETTS: Bigelow 6232 (MASS). MICHIGAN: Kauffman, 5 Oct 1912; Smith 80658 (holotype of *Marasmius epifagus* Gilliam). NEW YORK: Rogerson 3911 (NY).

Marasmius epifagus Gilliam differs from other species of the *Epiphylli* in several respects: (1) the pileus is light yellowish pink or pale yellow rather than white; (2) a partial adnate collar may sometimes connect one or two lamellae; and (3) the cuticular broom cells are not always smooth but may bear 1-4 conic projections. The species is nevertheless included in Section *Epiphylli* because *M. epifagus* lacks a complete, free collar and rhizomorphs and because the hymenial cystidia and basic cuticular structure resemble those of other *Epiphylli*.

5. MARASMIUS FELIX Morgan, J. Mycol. 12: 2. 1906.
FIG. 14

PILEUS 3-5 mm broad; pulvinate or convex at first, then plano-convex; dry; dull; opaque; chalky and smooth; at first even, becoming radially rugulose-striate; entire; tough-membranous. CUTICLE pruinose, with minute concolorous spicules overall; light yellowish pink (M&P 10A5-6, 10B6). TRAMA thin, or sometimes indistinguishable; concolorous with the cuticle. ODOR and TASTE lacking.

LAMELLAE narrow (0.2-0.5 mm broad); moderately thick; distant; few (10-11 reach the stipe); equal; adnate or often attached to a partial, adnate collar which may span up to 1/2 the circumference of the stipe; membranous; entire; not intervenose; often forked halfway to the stipe; usually crisped; yellowish white (M&P 9B2), blotched with moderate orange.

STIPE 25-45 mm long, 0.2-0.3 mm thick (long in relation to pileus size); central; terete; filiform and often tapered to the apex; hollow; delicate but pliant; even; minutely pruinose to spiculate overall; yellowish white (M&P 9B2) up to 3 mm from the apex downward, blackish brown below; insititious. STERILE STIPES distantly spaced along the substrate; up to 15 mm long; similar to the fertile stipes; black. RHIZOMORPHS lacking. BASAL MYCELIUM absent.

SPORES 7.7-11.2 X 3.1-5.3 µm; obovate or broadly fusoid-elliptic. BASIDIA 22-28(-33) X 5-8.5 µm; clavate; 4-spored. BASIDIOLES narrowly fusiform, with pinched apices.

HYMENIAL CYSTIDIA (11-)32-51 X 4-10(-16.5) µm; fusiform, fusoid-clavate, fusoid-ventricose, broadly clavate, or subglobose; capitate or mucronate, or if not, then rounded to acute apically; with hyaline walls up to 0.5 µm thick; projecting up to 10 µm beyond the basidioles; nonamyloid; abundant on the lamellar edges and faces.

TRAMAL HYPHAE of the pileus and lamellae 3-7 µm broad; loosely interwoven; uninflated; with hyaline walls up to 1 µm thick; nonamyloid.

PILEUS CUTICLE a hymeniform layer of two types of cells: (1) SMOOTH CELLS 9.5-16 X 2.5-11 µm, which are pyriform, obovate, clavate, elliptic, or lemon-shaped, with hyaline to pale orange yellow walls up to 3 µm thick; and (2) CYSTIDIA 18-27 X 4-6 µm, similar to the hymenial cystidia.

STIPE corticated in the pigmented portions only, the superficial hyphae elsewhere hyaline and thin-walled. CORTICAL HYPHAE 2-5 µm broad; with pale yellow to deep brown walls up to 1 µm thick. TRAMAL HYPHAE 2-6 µm broad; with hyaline walls up to 1 µm thick; nonamyloid. CYSTIDIA up to 25 X 8 µm; tapered, cylindric, subfusiform, fusoid-ventricose, short-clavate, or subglobose; with hyaline to pale orange yellow walls up to 2.5 µm thick; occasionally with hyaline incrustations; subcapitate, or if not, then rounded to acute apically; 0-1-septate; nonamyloid; abundant overall.

Solitary on scattered petioles of dead herbaceous vegetation at forest edge. Fruiting period uncertain.

Collections examined:

INDIANA: Gilliam 931. OHIO: Morgan 129, Preston, 1906 (2 specimens, syntypes of *Marasmius felix* Morgan, IA).

To my knowledge Gilliam 931 is the first collection of *Marasmius felix* Morgan since the original description in 1906. Features which, in combination, distinguish *M. felix* are a light yellowish pink pileus, pruinose lamellae blotched with orange, a densely pruinose stipe, prominent fusoid-ventricose cystidia on the pileus, stipe, and lamellae, and obovate or fusoid-elliptic spores. The occurrence on petioles of dicotyledonous herbs is unusual for North American Marasmii.

6. MARASMIUS CARICICOLA Kauffman in Pennington, N. Am. Fl. 9: 277. 1915.

"Pileus membranous, somewhat tough, pliant, convex-expanded, obtuse, gregarious, 4-8 mm broad; surface broadly sulcate or alveolate, pruinose, pure-white; spores 15-18 X 6-6.5 μ; basidia 2- or 4-spored; stipe very short, terete, equal, subglabrous, pure-white, inserted by a naked base, 2 mm long, 0.7 mm thick." (25).

Gregarious on culms of *Carex*.

Collection examined:

MICHIGAN: Kauffman, Oct 1907 (holotype of *Marasmius caricicola* Kauffman).

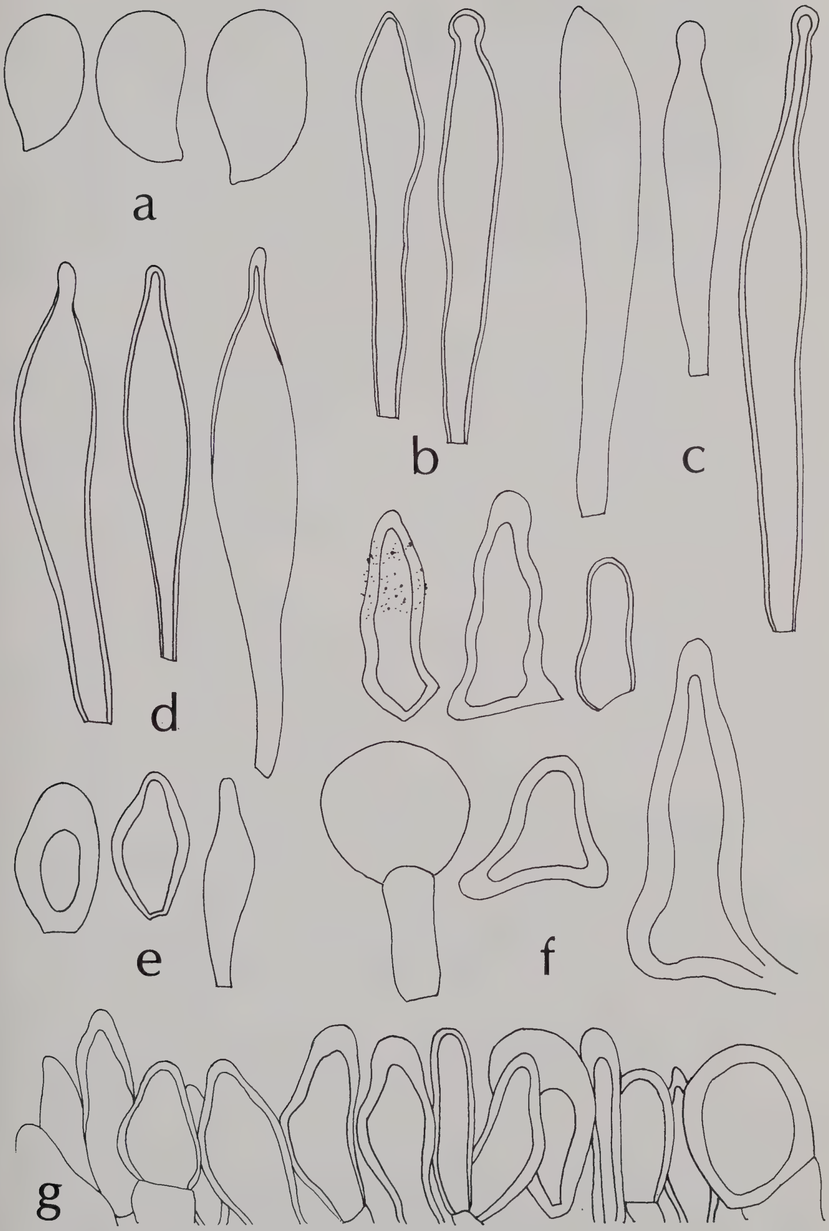
Marasmius caricicola is known only from the type specimen, which has been poorly preserved. No microscopic features are discernible. The white, pruinose pileus and insititious stipe suggest that *M. caricicola* belongs in section *Epiphylli*. According to Kauffman's measurements *M. caricicola* has larger spores than other species in the section.

7. MARASMIUS EPIPHYLLUS (Persoon ex Fries) Fries, Epicr. Myc. 386. 1838. FIG. 15

Agaricus epiphyllus Persoon ex Fries, Syst. Myc. 1: 139. 1821.

Marasmius subvenosus Peck, Annual Rep. New York State Mus. 23: 125. 1869 (1872). *pl. 6, f. 15-21.*

Figure 14. *Marasmius felix*. a. Spores, Gilliam 931, x2300. b-f. x1500. b. Cystidia from lamellar faces, Gilliam 931. c. Cystidia from lamellar faces, Morgan 129 (Type). d. Cystidia from lamellar edge, Gilliam 931. e. Cells from pileus cuticle, Morgan 129 (Type). f. Cells from pileus cuticle, Gilliam 931.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PILEUS 1-7 mm broad; nearly pulvinate at first, then convex to plano-convex or sometimes plane, rarely with a slight central depression; dry; dull; opaque, becoming translucent in age; smooth at first, in age and upon drying minutely rugulose; even or obscurely and irregularly striate; entire to crenate; fragile-membranous; reviving. CUTICLE minutely pruinose to minutely velutinous; white to yellowish white, becoming pale yellow to light orange yellow centrally in age and upon drying. TRAMA scarcely distinguishable; yellowish white or white. ODOR and TASTE lacking.

LAMELLAE narrow, almost veinlike (usually less than 0.5 mm broad, but up to 1.0 mm); thin or somewhat thick; distant to remote; few (up to 13 reach the stipe) or rarely lacking altogether; equal or unequal, with 1-4 short veinlike lamellulae; adnate or sometimes attached in pairs to a partial, adnate collar; fragile-membranous; entire; straight; usually intervenose; occasionally forked; pruinose; white to yellowish white, drying pale yellow.

STIPE (2-)6-17(-35) mm long, 0.1-0.3 mm thick; central; terete; equal or enlarged slightly at the apex or base; straight, but curling upon drying; dry; shining; translucent overall at first, soon opaque except at the apex; hollow; delicate at first, then bristle-like; even; pruinose overall with short, yellowish white to reddish brown hairs; yellowish white overall at first, remaining so on the apical 2 mm and becoming light yellowish brown (Wood Brown) or moderate yellowish brown (Sayal Brown) to deep brown below, sometimes dark brown or blackish brown at the base in age; insititious. STERILE STIPES sometimes present; tapered; similar to the fertile stipes. RHIZOMORPHS lacking. BASAL MYCELIUM usually absent, or rarely with an inconspicuous fringe of hairs around the point of emergence.

SPORES white in mass; (7.1-)8.1-11.6(-12.6) X 2.8-4.5 µm; pip-shaped or subcylindric. BASIDIA 21-39 X 5.5-10 µm; clavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA (15.5-)29-60 X 3-10 µm; fusoid-ventricose or subfusiform and often narrowed to a short neck; with hyaline walls up to 0.5 µm thick; projecting up to 35 µm beyond the basidioles; nonamyloid; occasional to abundant on the edges and faces of the lamellae.

TRAMAL HYPHAE 2-6 μm broad in the pileus and lamellae; loosely interwoven; uninflated; with hyaline walls up to 0.5(-1) μm thick; nonamyloid.

PILEUS CUTICLE a hymeniform layer of two types of cells: (1) SMOOTH CELLS 8-32 X 5.5-17 μm, which are obovate, subglobose, lemon-shaped, or subcylindric and occasionally pedicellate, with hyaline walls up to 0.5 μm thick; and (2) CYSTIDIA 21-46 X 4-11 μm, which are fusoid-ventricose to fusiform or evenly tapered, with hyaline walls up to 0.5 μm thick.

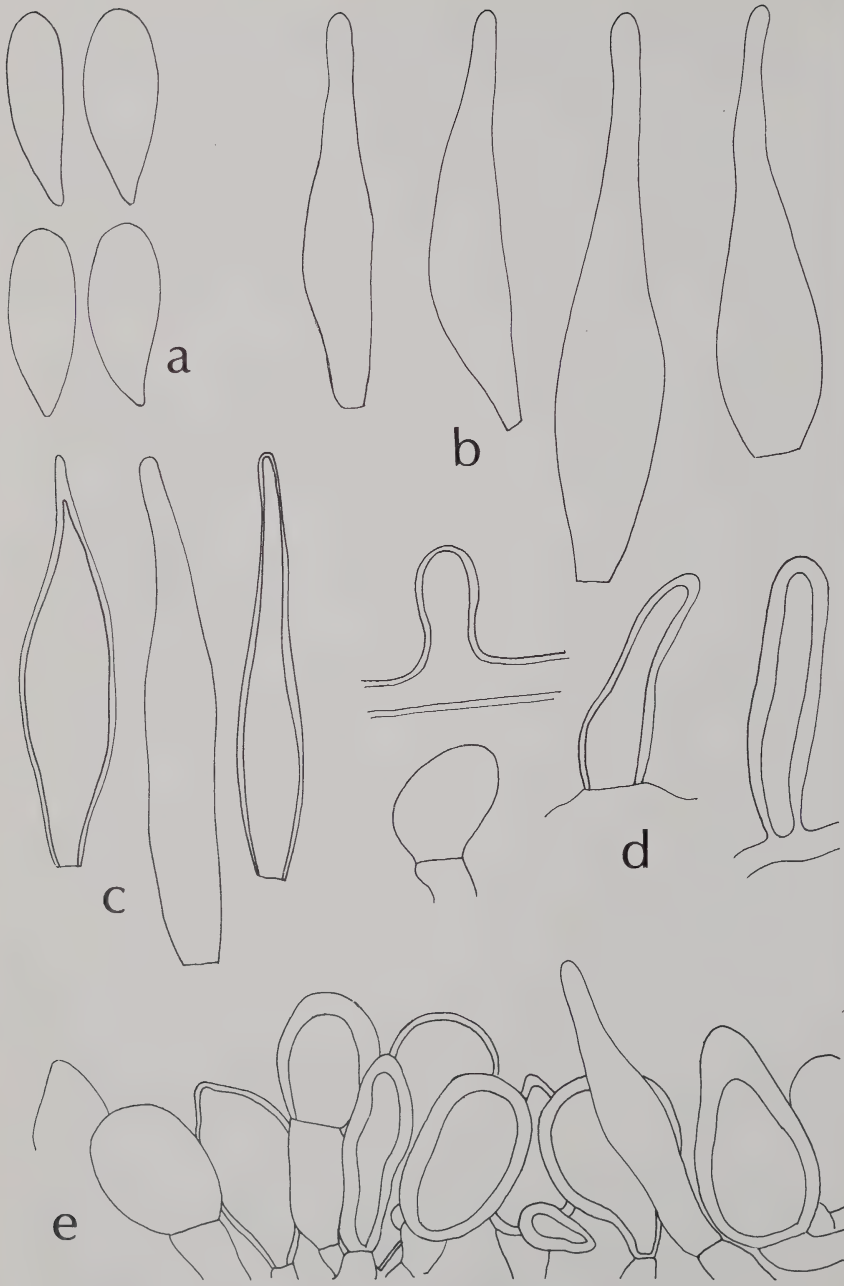
STIPE corticated in pigmented portions only, the superficial hyphae elsewhere hyaline and thin-walled. CORTICAL HYPHAE 1.4-4 μm broad; with light yellowish brown or deep brown walls up to 1.5 μm thick; nonamyloid. TRAMAL HYPHAE 1-6 μm broad; with hyaline walls up to 1 μm thick; nonamyloid. HAIRS up to 20(-56) X 8 μm; subcylindric, subclavate, or fusoid-ventricose and occasionally branched; with hyaline to light orange yellow walls up to 1 μm thick; rarely septate; abundant overall.

Gregarious on leaves and petioles of Betulaceae, or rarely of *Quercus*, *Prunus*, or *Fraxinus* in deciduous woods. Fruiting period: 28 Aug-2 Oct (-11 Nov, Washington).

Collections examined:

CANADA: MANITOBA: Bisby, 9 Sep 1921. ONTARIO: Groves 10518. GERMANY: Sydow, *Mycotheca Germanica* 101. UNITED STATES: COLORADO: Simms Sf-37 & Sf-275 (NY); Smith 51488, 51763, 52153. IDAHO: Cooke 21380 (NY); Smith 53753, 54089; Wehmeyer, 7 Sep 1922. MICHIGAN: Ammirati 4057; Gilliam 1234, 1442, 1472, & 1476; Kauffman, 18 Sep 1929; Potter 9093; Shaffer 2525; Smith 33-884 & 22320. MINNESOTA: Weaver 1917 & 2078. NEW MEXICO: Barrows 1782. NEW YORK: Peck, Oct 1869 (holotype of *Marasmius subvenosus* Peck, NYS). WASHINGTON: Cooke 18924. WISCONSIN: Gilliam 1232.

No holotype of *Marasmius epiphyllus* exists, but Singer (40) has recently designated a neotype which I have not as yet seen. According to Singer, specimens of *M. epiphyllus* show considerable variation with respect to the thickness of the cuticular cell walls.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MARASMIUS section GLOBULARES ['Globularini'] Kühner,
Botaniste 25: 100. 1933.
Scorteus Earle, Bull. New York Bot. Gard. 5: 415.
1909.
Type species: *Marasmius globularis* Quélet, Mem. Soc.
Émul. Montbéliard II, 5: 220. 1872.

Pileus medium-sized to large (11-65 mm broad), smooth or rugulose, not striate or sulcate, fleshy, firm, variously colored. Odor lacking or of cyanic acid or raphanoid. Taste bitter or raphanoid, sometimes lacking. Lamellae thin or somewhat thick, well-developed, moderately numerous to numerous, distant to crowded, unequal, adnexed to free. Stipe moderately thick (2-9 mm thick), cartilaginous, fibrillose or tomentose, with a short pseudorhiza or not, not insititious. Rhizomorphs and sterile stipes absent. Basal mycelium present.

Spores obovate, pip-shaped, or elliptic. Hymenial cystidia present or not. Trama dextrinoid. Pileus cuticle a hymeniform layer of smooth cells. Stipe cortex of thin- to thick-walled, smooth, usually dextrinoid hyphae. Stipe vesture of filamentous, thick-walled hairs or rarely lacking.

On humus or on soil in open, grassy areas or deciduous or coniferous woods.

8. MARASMIUS OREADES (Bolton ex Fries) Fries, Epicr. Myc.
375. 1838. FIGS. 16 & 20
[*Agaricus caryophylleus* Schaeffer, Fung. Bavar.
4: 38. 1774.]
[*Agaricus oreades* Bolton, Hist. Fung. Halifax 3:
151. 1789.]
Agaricus oreades Bolton ex Fries, Syst. Myc. 1:
127. 1821.
Marasmius caryophylleus (Schaeffer) ex Schröter
in Cohn, Krypt.-Fl. Schles. 3A: 561.
1889.
Scorteus oreades (Bolton ex Fries) Earle, Bull.

Figure 15. *Marasmius epiphyllus*, Gilliam 1234. a. Spores, x2300. b-e. x1500. b. Hymenial cystidia. c. Cystidia from lamellar edge. d. Pileus cuticular cells. e. Cystidia from stipe.

New York Bot. Gard. 5: 415. 1909.
Collybia oreades (Bolton ex Fries) Kummer, Die
Führer in die Pilzk. 116. 1871.

PILEUS 11-43 mm broad; at first bluntly conic or campanulate with the margin incurved, then convex to umbonate, in age convex to plano-convex with a wavy, uplifted margin; shiny when moist, soon dull; opaque or translucent-striate up to 3 mm inward when moist; smooth or pitted; entire; firm; reviving. CUTICLE usually glabrous, sometimes with powdery white patches overall at first or finely felted upon drying; deep brown (M&P 8A12) in primordia, then light yellowish brown (M&P 11E7, 13D9, 13E10) or light grayish brown (M&P 14A-D8, 14C7), hygrophanous and fading to light yellowish brown or yellowish white, occasionally tinged grayish red (M&P 6J8) in bruised areas, rarely light yellow or light yellowish pink (M&P 11A7) to grayish red (M&P 6J8) or dark reddish brown (M&P 8L9) overall. TRAMA up to 6.5 mm thick; white or yellowish white. ODOR of cyanic acid; faint or strong. TASTE mild or lacking.

LAMELLAE narrow at first, in age up to 5 mm broad; rather thick; close to distant; moderately numerous (20-28 reach the stipe); unequal, with 1-5 tiers of lamellulae; adnexed to free; tough; entire; straight or subventricose; intervenose or not; rarely forked; yellowish white.

STIPE 12-70 mm long, 2-4.5 mm thick; central; terete or compressed upon drying; equal, broader at the base, or subbulbous and often with a short, tapered pseudorhiza; straight; dry; dull; opaque; solid or stuffed; firm and rigid; even or with twisted longitudinal ribs; tomentose, hirsute, minutely felted, or fibrillose-squamulose basally or overall, the vesture white to yellowish white (M&P 9B-C2) or moderate orange yellow (M&P 9F2, 9G3) above, light yellowish brown to light reddish brown below or sometimes overall. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM continuous with the stipe vesture; inconspicuous.

SPORES white in mass; (6.3-)7.0-10.0 X 3.5-6.0 µm; obovate, ovate, lemon-shaped, fusoid-elliptic, or rarely subglobose. BASIDIA 33-45 X 5.5-8.5 µm; subclavate to clavate, with a long, narrow basal portion. BASIDIOLES subclavate.

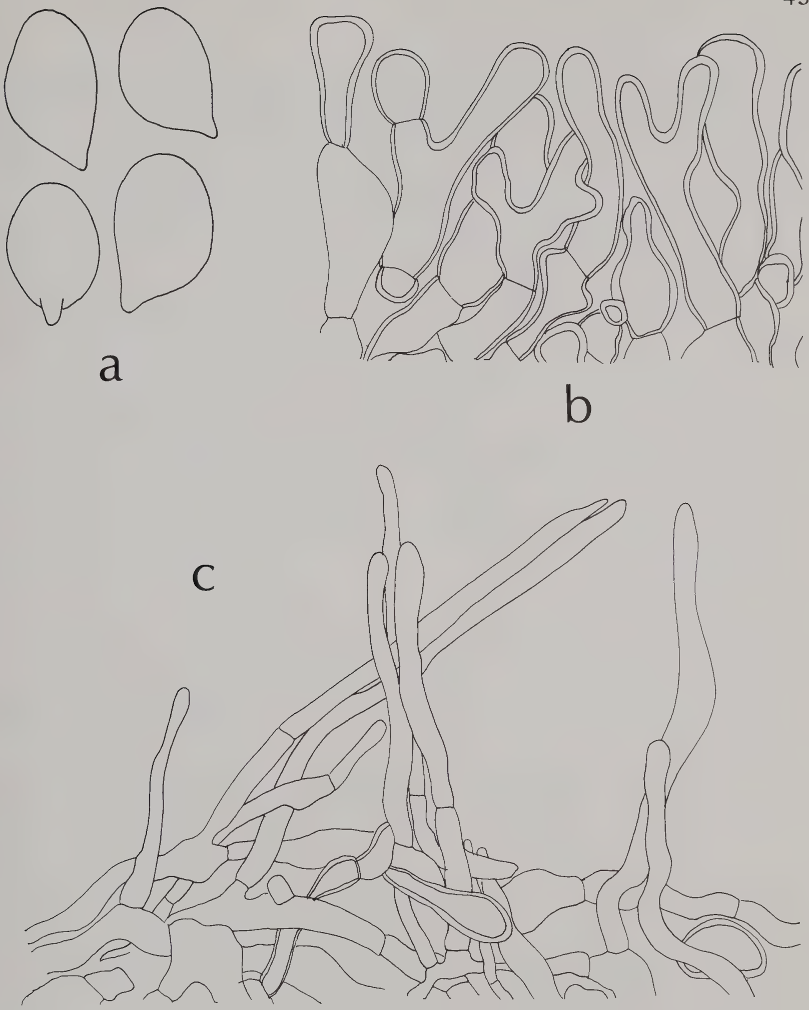

Figure 16. *Marasmius oreades*, Gilliam 752. a. Spores, x2300. b. Radial section of pileus cuticle, x1500. c. Longitudinal section of stipe surface layer, x850.

HYMENIAL CYSTIDIA lacking.

TRAMAL HYPHAE interwoven and up to 14 µm in the pileus; parallel-interwoven, uninflated, and 2-5.5 µm broad in the lamellae; with hyaline to light yellow walls up to

1 µm thick or rarely with the wall completely occluding the lumen; dextrinoid or rarely nonamyloid in the lamellae.

PILEUS CUTICLE a hymeniform layer of clavate, cylindric, deeply lobed, or short-branched smooth nonamyloid cells 15-39 X 3-8(-18) µm, with hyaline to light grayish yellow walls up to 0.5(-1) µm thick.

STIPE uncorticated overall. SURFACE AND TRAMAL HYPHAE 3-8.5 µm broad; with thin, hyaline to light yellowish brown walls; dextrinoid. STIPE HAIRS up to 12 µm broad; with hyaline to light yellowish brown walls up to 1 µm thick; usually with cylindric to clavate end cells; dextrinoid; forming a tangled layer up to 400 µm thick.

Scattered, gregarious, or cespitose, often in fairy rings, in lawns or meadows, rarely under spruce. Fruiting period: 20 May-29 Oct.

Collections examined:

ARGENTINA: Singer & Wright S229 & S363. CANADA: NOVA SCOTIA: Wehmeyer 250. ONTARIO: Kelly 752. QUEBEC: Bigelow 5007 (MASS); Shaffer 5985. ENGLAND: BUCKINGHAMSHIRE: Dennis, 15 Sep 1951. FRANCE: OISE: Roumeguère, *Fungi Gallici Exsiccati* 2002 (NY). GERMANY: Shaffer 5001; Sydow, *Mycotheca Germanica* 1407. JAPAN: Wright, 1853-1856 (FH). SWEDEN: Linder, 24 Jun 1927 (FH); Lundell, 10 Jul 1945. UNITED STATES: COLORADO: Shushan 102 (NY). CONNECTICUT: Earle, 18 Jul 1902 (NY). MAINE: Morse, 10 Oct 1935 (FH). MARYLAND: Kelly 532; Scribner, Oct 1886 (BPI). MASSACHUSETTS: Bigelow 6736 (MASS), 7953 (MASS), 8460 (MASS), & 9107 (MASS); Gilgut 54 (FH); Langer, Jun 1904 (FH); Singer, 20 May 1942 (FH). MICHIGAN: Gilliam 500, 505, 539, 742, 875, 1312, & 1443; Hicks 646 (FH); McVaugh 14688; Patrick 1116; Potter 5250 & 6799; Smith 15566, 42336, 58298, & 66316. MINNESOTA: Weaver 1036. MISSOURI: Routien, 15 Jun 1940 (NY). NEW JERSEY: Ellis & Everhart, *Fungi Columbiani* 1002 (BPI). NEW YORK: Burt, Jul 1895; Gilliam 1246; Kauffman, 31 Aug 1903. OKLAHOMA: Bulmer, 8 Sep 1963. OREGON: Sprague, 19 May 1951 (NY). SOUTH DAKOTA: Shaffer 6785. VERMONT: Bigelow 12772 (MASS); Pringle 1320 (FH). VIRGINIA: Kelly 350. WISCONSIN: Mazzer 6305, 6536, & 6539. WYOMING: Ferrell, Jul 1961.

Marasmius oreades is another Friesian name for which there is no holotype. The Lundell exsiccati specimen from Uppsala, Fries' principal collecting site, fits the North American concept of the species.

For such a widespread species, *Marasmius oreades* shows surprisingly little variation. The most striking variant, which seems to be limited to spruce, occurs both in Europe (23) and the United States (e.g., Gilliam 500 & 505). Early in the season such collections have light yellowish pink, grayish red, or reddish brown pilei, but collections from the same site later in the season (Gilliam 539) resemble typical *M. oreades* in color.

A gastroid form of *Marasmius oreades* is occasionally found when the season has been marginal for fruiting. Such basidiocarps (e.g., Gilliam 1443) grow among normal basidiocarps and, if even a rudimentary lamella or two is present, may be fertile.

Since the lamellae continue to increase in breadth and to produce spores as the basidiocarp ages, fertile specimens may be encountered in which the hymeniform structure of the pileus cuticle has degenerated.

Mounts of tramal tissue may be strongly to weakly dextrinoid or even partially nonamyloid. Stipe tramal tissue is nearly always dextrinoid.

9. MARASMIUS CYSTIDIOSUS (A. H. Smith & Hesler) Gilliam, comb. nov.

FIG. 17

Collybia cystidiosa A. H. Smith & Hesler, J.
Elisha Mitchell Sci. Soc. 56: 305.
pl. 8, f. 1, 3, 4, 6. 1940.

PILEUS 20-45 mm broad; at first convex, then convex-umbonate with the margin elevated and undulate; subhygrophanous; subshiny; slightly sticky; rivulose or rugose to the smooth umbo; translucent-striate on the margin when moist; entire, but split in age; pliant. CUTICLE glabrous; light yellowish brown or light yellowish pink (Pinkish Buff) on the margin, dark orange yellow (Ochraceous-Tawny) to moderate yellowish brown (Sayal Brown) on the umbo. TRAMA moderately thin (2.5 mm thick on the disc in a pileus 45 mm broad, indistinguishable on the margin); when moist translucent light yellowish brown, otherwise white. ODOR mild or pungent. TASTE bitter.

LAMELLAE narrow at first, soon moderately broad (2.5-4.5 mm broad); thin; close; numerous; unequal, with numerous short, thin lamellulae; adnexed; pliant; often minutely fimbriate; broadest near the stipe, acute in front; faintly intervenose; occasionally forked about 1 cm from the pileus edge, less frequently elsewhere; crisped; yellowish white to white.

STIPE 30-65 mm long, 3-6 mm thick; central; terete; subbulbous; curved near the base; dry; shining; translucent when moist; striatulate from the midportion to the base; hollow; glabrous above, with white or yellowish white fibrils near the base; white at the apex, pale yellow below, then light yellowish brown. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM white.

SPORES white in mass; 7.6-10.5(-12.5) X 2.8-3.9 µm; narrowly fusoid-elliptic or narrowly elliptic. BASIDIA 22-31 X 5.5-8.5 µm; clavate; 4-spored. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 18-76 X 4-11 µm; fusiform, fusoid-ventricose, fusoid-clavate, lanceolate, or subcylindric; subcapitate or capitate, or if not, then rounded or subacute apically; with hyaline or pale yellow, thin walls; projecting up to 20 µm beyond the basidioles; nonamyloid; abundant on the lamellar faces and edges.

TRAMAL HYPHAE 2-8 µm broad in both pileus and lamellae; interwoven in the pileus, parallel-interwoven in the lamellae; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of clavate, globose, subglobose, turbinate, or cylindric smooth nonamyloid cells 7-23 X 5.5-12(-15) µm, with hyaline to pale yellow walls up to 1 µm thick, sometimes with brown incrustations.

STIPE corticated in the pigmented portions only, the superficial hyphae elsewhere hyaline and thin-walled. CORTICAL HYPHAE 2-10 µm broad; with light yellowish brown walls up to 3 µm broad; dextrinoid. TRAMAL HYPHAE 1.5-11 µm broad; with thin, hyaline walls. STIPE VESTURE lacking.

Scattered to gregarious on leaf mold and twigs in deciduous woods. Fruiting period: 4 Jul-5 Sep.

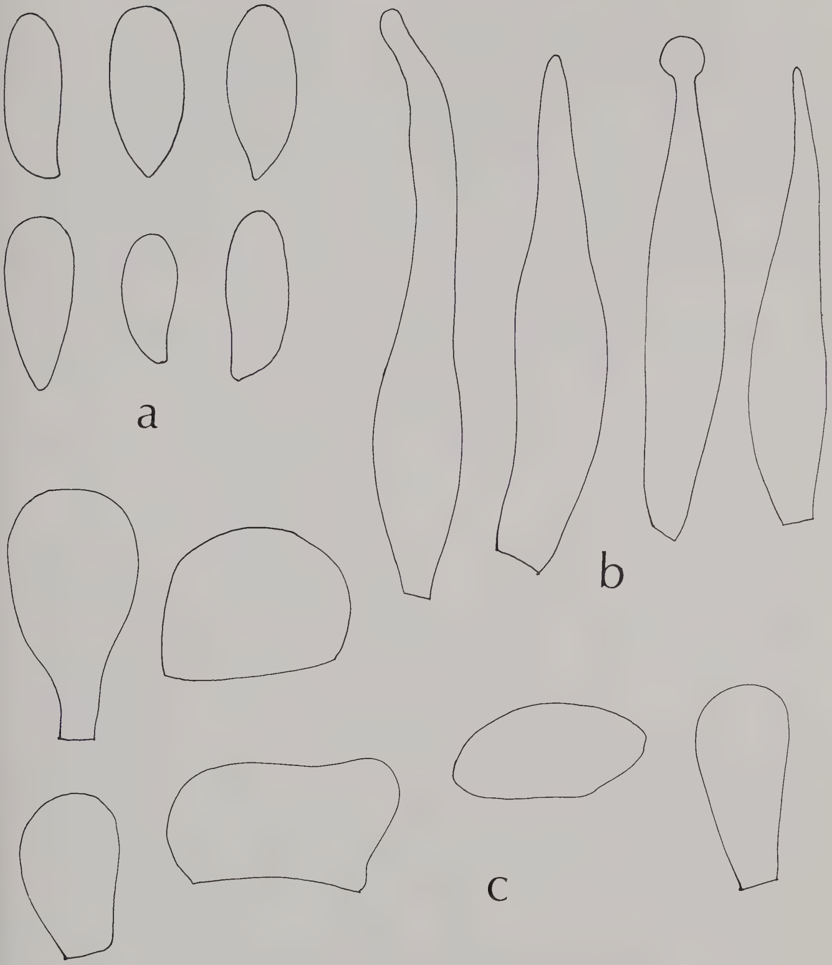

Figure 17. *Marasmius cystidiosus*, Weaver 7-4-62-N-1.
a. Spores, x2300. b. Hymenial cystidia, x1500.
c. Cells from pileus cuticle, x1500.

Collections examined:

MINNESOTA: Weaver 7-4-62-N-1. NORTH CAROLINA: Hesler 12195 (holotype of *Collybia cystidiosa* A. H. Smith & Hesler) & 14266; Smith 7416 & 7437 (paratypes of *C. cystidiosa*).

The description of macroscopic characters has been adapted from notes by Margaret G. Weaver and from notes present with the type collection. Study of type specimens established the identity of the Minnesota specimens, suggested by Mrs. Weaver. The hymeniform cuticle and dextrinoid trama indicate, according to the generic concept used here, that the species belongs in *Marasmius* rather than *Collybia*. Microscopically *Marasmius cystidiosus* is indistinguishable from collections determined as *M. fasciatus* Pennington. See the discussion of the latter species in the appendix under *M. anomalus* Peck non Lasch.

10. MARASMIUS STRICTIPES (Peck) Singer, Ann. Mycol. 41: 130. 1943. FIGS. 18 & 19
Collybia strictipes Peck, Annual Rep. New York State Mus. 41: 62. 1887 (1888).
Gymnopus strictipes (Peck) Murrill, N. Am. Fl. 9: 357. 1916.

PILEUS 20-65 mm broad; at first convex, then broadly convex to convex-umbonate, in age plano-convex, often with a flared margin; moist and subhygrophanous; dull; somewhat translucent; smooth or becoming rugulose; even or faintly translucent-striate up to 3 mm inward; entire; firm. CUTICLE glabrous; pale yellow, light yellow, pale orange yellow (Warm Buff) or moderate orange yellow (Ochraceous-Buff) on the margin, fading upon drying, often irregularly blotched on the disc with strong orange yellow (Ochraceous-Orange), deep orange (Orange-Rufous), strong orange, or strong yellowish brown. TRAMA thin (up to 3 mm thick); translucent yellowish white, fading to white. ODOR mild and nondescript or raphanoid. TASTE slightly raphanoid.

LAMELLAE narrow (up to 4 mm broad); moderately thick; close to crowded; numerous; unequal, with numerous lamellulae; adnate to deeply sinuate and often seceding; fleshy-brittle; entire or minutely crenate or eroded; ventricose; not intervenose; occasionally forked; pale orange yellow (Pale Pinkish Buff), pale yellow, or yellowish white.

STIPE 22-85 mm long, 3-9 mm thick; central; terete or compressed; equal or slightly enlarged at the base; straight or curved; dry; dull; opaque; hollow; cartilaginous; even; minutely pruinose overall or matted-fibrillose centrally and pruinose above; nearly white or pale yellow. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM of pale yellow, erect or appressed fibrils; often matting several leaves together; abundant.

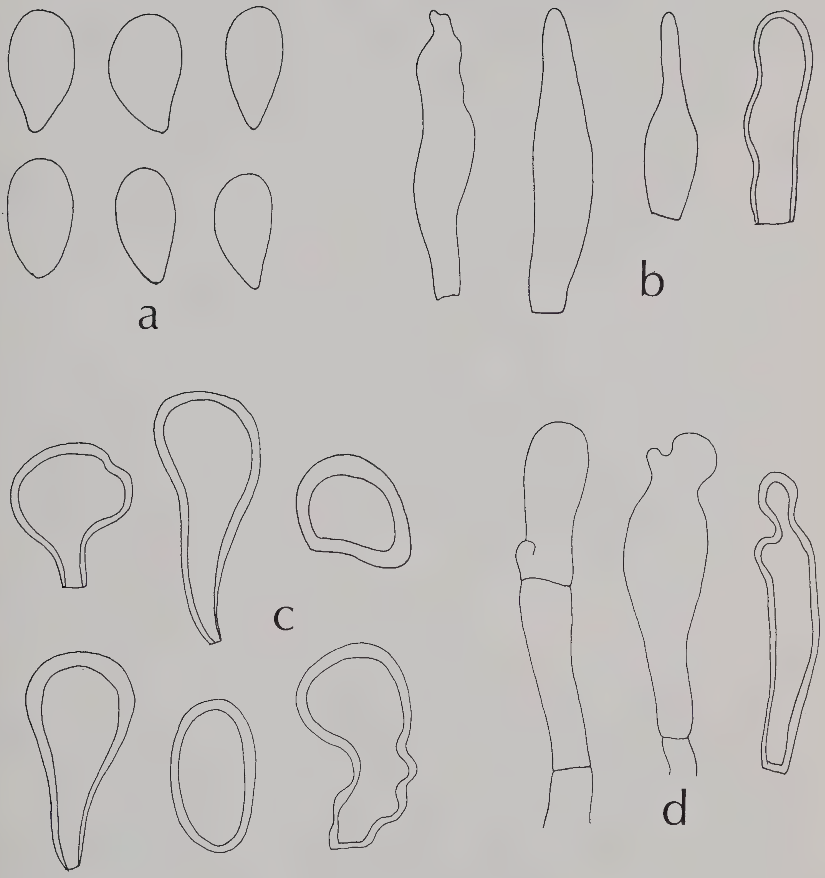

Figure 18. *Marasmius strictipes*, Bigelow 7493. a. Spores, x2300. b. Cystidia from lamellar edge, x1500. c. Cells from pileus cuticle, x1500. d. Cystidia from stipe, x1500.

SPORES white in mass; 6.3-10.5 X 3.0-4.5 µm; pip-shaped or fusoid-elliptic. BASIDIA 18-29 X 5-8 µm; clavate to subclavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA 14-35 X 4-9 µm; cylindric, fusoid-clavate, or clavate and often wavy in outline; occasionally branched or lobed; with hyaline walls up to 1 µm thick; projecting up to 20 µm beyond the basidioles; present only on the lamellar edges.

TRAMAL HYPHAE 3-11 µm broad in the lamellae, inflated up to 20 µm in the pileus; interwoven; with hyaline or pale yellow walls up to 1 µm thick; dextrinoid.

PILEUS CUTICLE a hymeniform layer of clavate, obovate, or subcylindric and sometimes lobed, branched, or pedicellate smooth cells 11-30 X 8-20 µm, with hyaline to pale yellow walls up to 1(-2) µm thick; sometimes with the subterminal cells inflated as well; dextrinoid.

STIPE corticated thinly or not at all. CORTICAL HYPHAE 4-12 µm broad; with hyaline to pale yellow walls up to 1.5 µm thick; dextrinoid. TRAMAL HYPHAE 4-20 µm broad; with hyaline or rarely pale yellow walls up to 1.5 µm thick; or occasionally with the wall material occluding the lumen; dextrinoid. STIPE HAIRS 4-7 µm broad; fusoid-clavate, cylindric, or subclavate; occasionally subcapitate; with hyaline walls up to 1 µm thick; abundant.

Scattered to gregarious or rarely subcespitose on fallen leaves in deciduous woods. Fruiting period: 8 Jul-10 Sep.

Collections examined:

MAINE: Bigelow 10438 (MASS), 10540 (MASS), & 11411 (MASS). MASSACHUSETTS: Bigelow 7493 (MASS) 9784 (MASS), & 14532 (MASS). MICHIGAN: Gilliam 789; Smith 15295. NEW YORK: Peck, Sep (holotype of *Collybia strictipes* Peck, NYS). OHIO: Gilliam 1499. TENNESSEE: Hesler 17700.

Bigelow & Barr's (2) excellent description of *Marasmius strictipes*, based on many of the same specimens as those cited above, needs little amendment. Although they state that basidiocarps usually occur singly, which I have found to be true in general, Smith 15295 consists of many

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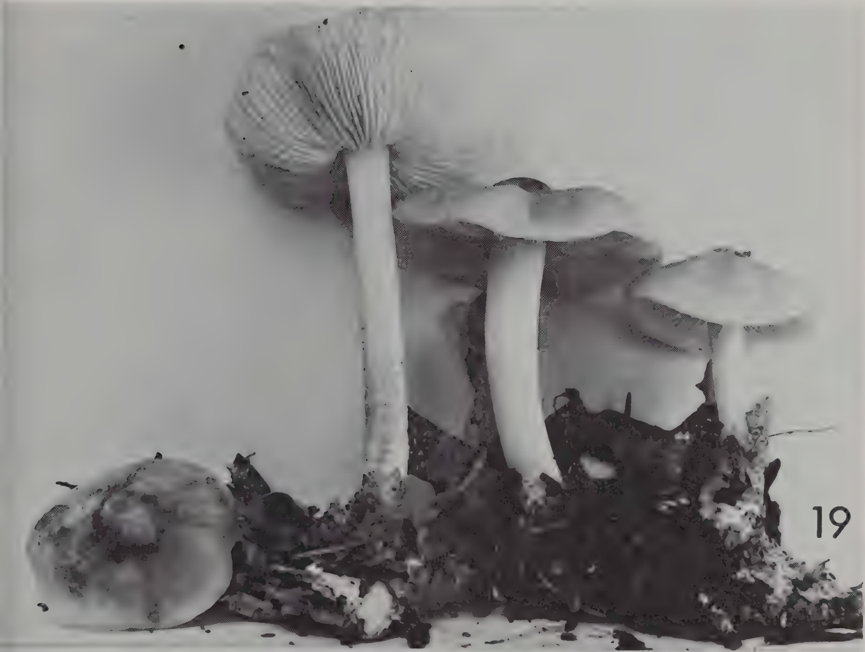
Figure 19. *Marasmius strictipes*, Bigelow 13093, x3/4. (courtesy of Howard E. Bigelow)

Figure 20. *Marasmius oreades*, x3/4. (courtesy of Howard E. Bigelow)



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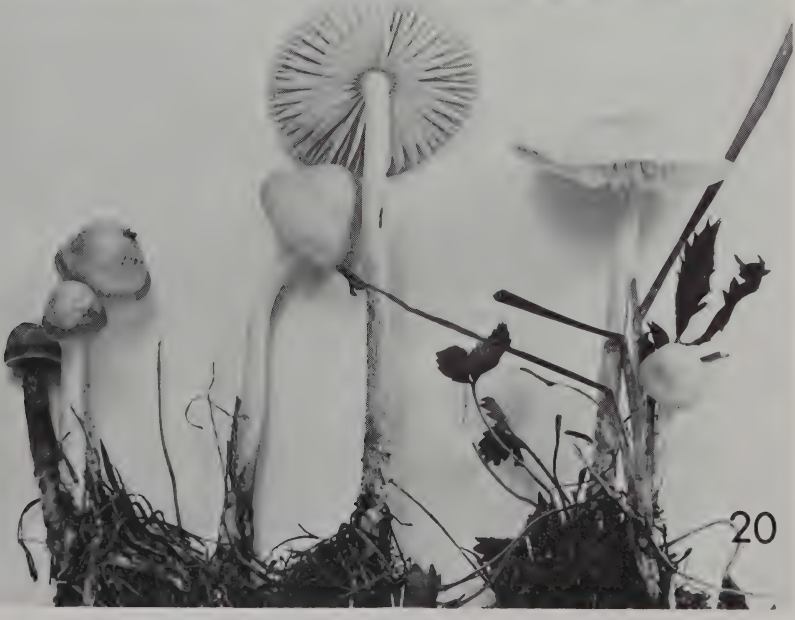

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basidiocarps, a large number of which are united at the base in pairs. Singer's (36) description of Mexican material tallies well with other North American collections of *M. strictipes*.

MARASMIUS section SICCI Singer, Mycologia 50: 106. 1958.

Type species: *Marasmius siccus* (Schweinitz) Fries, Epicr. Myc. 382. 1838.

Pileus small to large, smooth or granular-roughened, even or striate to sulcate, usually thin, tough-membranous, variously colored. Odor nondescript or fragrant, rarely with a foetid or spermatic component. Taste bitter, spermatic, or nondescript. Lamellae thin, well-developed, few to moderately numerous, distant to close or rarely crowded, usually unequal, adnexed to free. Stipe thin, bristle-like to cartilaginous, glabrous or pruinose, not insititious. Rhizomorphs and sterile stipes absent. Basal mycelium often tuftlike.

Spores clavate or pip-shaped to fusoid-elliptic. Hymenial cystidia often present, hyaline or pale yellow, often capitate, on the faces and sometimes on the edges of the lamellae. Hymenial setae present or not. Hymenial broom cells usually present on the lamellar edges. Trama dextrinoid. Pileus cuticle a hymeniform layer of cylindric to clavate broom cells with rodlike or finely divided projections, sometimes also with setae or smooth cells. Stipe cortex of smooth, thick-walled hyphae. Stipe vesture lacking, or of broom cells, smooth cells, clavate cells, or setae or a combination of these.

On humus, leaves of deciduous trees, or needles of coniferous trees.

11. MARASMIUS DELECTANS Morgan, J. Mycol. 11: 206. 1905.

FIGS. 21 & 22

PILEUS 7-40 mm broad; deeply pulvinate, conic-convex, or broadly convex at first, often with the margin incurved, then convex to plano-convex and sometimes minutely papillate, subumbonate, or umbilicate centrally, finally plane or concave with the margin uplifted and wavy; dry; dull; opaque or rarely translucent-striate in age; smooth at first, then rugulose or rivulose overall; even or obscurely rugulose-striate 3-6 mm from the edge inward; entire to

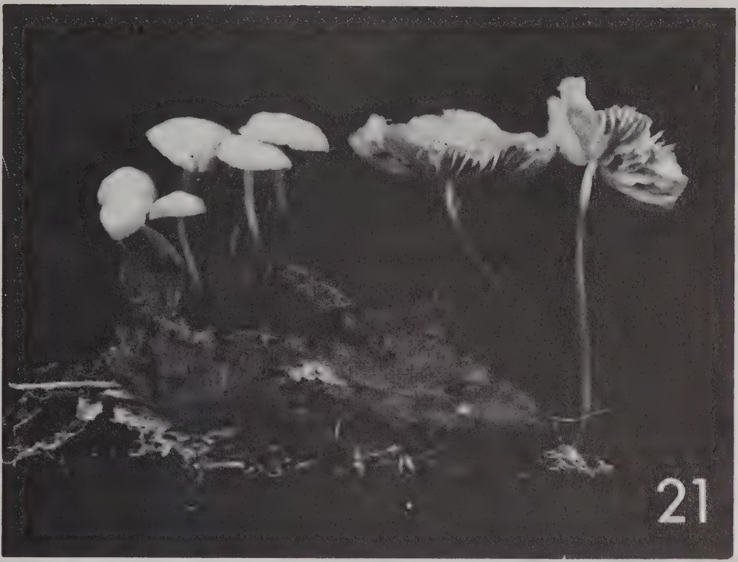

Figure 21. *Marasmius delectans*, Gilliam 1520, x1.

crenate; tough; reviving. CUTICLE minutely velutinous; yellowish white, pale yellow (Cartridge Buff, M&P 9J4), light yellow (Cream Color), moderate yellow (Chamois), or pale orange yellow (M&P C-E2), often with the darker colors on the disc only, pale yellow to moderate orange yellow in dried specimens. TRAMA thick at first (1.5-3 mm thick in the disc), thinner in age; white to yellowish white. ODOR usually mild and fragrant, but sometimes strong and with a foetid or spermatic component which may be marked in dried and remoistened specimens. TASTE mild or lacking.

LAMELLAE moderately broad (up to 4 mm broad in a pileus 30 mm broad); usually thin; subdistant to distant or rarely close; numerous (16-30 reach the stipe); unequal, with numerous lamellulae in 2-3 tiers; adnate, adnexed, or free; pliant; entire or minutely fimbriate; straight at first, then ventricose; prominently intervenose; not forked; often crisped; yellowish white or pale orange yellow, darker (pale yellow to light yellowish brown) in dried specimens.

STIPE 8-75 mm long, 1-1.6(-3.5) mm thick; central; terete; equal, swollen at the apex or tapered evenly to the base; straight or curved; dry; shining; opaque; hollow; cartilaginous; even; glabrous or rarely pruinose near the base; yellowish white, pale yellow (Ivory Yellow), pale orange yellow (M&P 9C3, 9D2), or rarely deep red on the upper 1/3 to 1/2 at first, darkening from the base upward through light yellowish brown (M&P 11G6), strong brown (M&P 14A12), deep brown, or grayish brown (Benzo Brown, Warm Sepia, Vandyke Brown) to dark grayish brown, brownish black, or black, in age these darker colors overall except at the extreme apex. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM cottony on the stipe, forming a flat sheet on the surrounding substrate; white.

SPORES white to yellowish white in mass; 5.6-8.7(-10) X 2.8-5 μm; narrowly to broadly elliptic, obovate, ovate, fusoid-elliptic, or pip-shaped. BASIDIA 22-42 X 4-7 μm; subclavate to clavate; 4-spored. BASIDIOLES subclavate.

HYMENIAL SETAE (4-)14-73 X 1.5-11 μm; usually fusoid-ventricose with a long, tapered neck, otherwise clavate, fusiform, subcylindric, or obovate, often constricted 1-several times; sometimes branched and then approaching the shape of broom cells; capitate, submoniliform, or truncate, or simply rounded to acute apically; with hyaline to pale orange yellow walls up to 3 μm thick which often occlude the lumen; empty; dextrinoid; embedded or projecting up to 50 μm beyond the basidioles; usually abundant on the lamellar edges and faces.

TRAMAL HYPHAE interwoven and inflated up to 11 μm broad in the pileus; parallel to interwoven, uninflated, and 2.5-5.5 μm broad in the lamellae; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE hymeniform, at first consisting of irregular broom cells which intergrade into setae, then of a combination of broom cells and smooth cells, finally almost entirely of smooth cells. CUTICULAR BROOM CELLS 6.5-21 X 6-10 μm; clavate, subcylindric, fusiform, or obovate and sometimes pedicellate; with 3-8 divergent, smooth, sometimes branched, dextrinoid knoblike or rodlike projections 2-14 X 5.5-17 μm or sometimes with only 1 or 2 projections and then transitional to setae; with hyaline walls up to 2-5 μm thick. SMOOTH CELLS 10-25 X 5.5-17 μm; subglobose, obovate, clavate, turbinate, or variously lobed; with hyaline walls up to 3 μm thick;

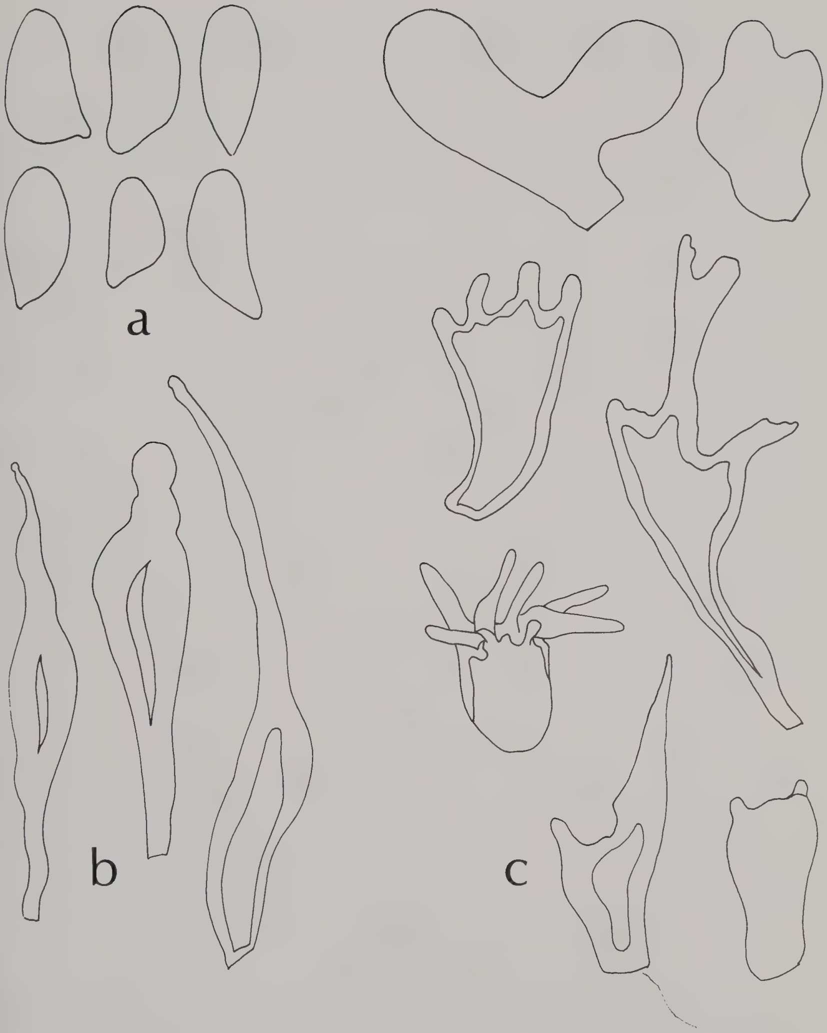

Figure 22. *Marasmius delectans*, Gilliam 771. a. Spores, x2300. b. Hymenial setae, x1500. c. Broom cells and setae from pileus cuticle, x2300.

dextrinoid or nonamyloid.

STIPE corticated only in pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated except in having walls up to 3 µm thick; dextrinoid. TRAMAL HYPHAE up to 12 µm broad; with hyaline walls up to 1 µm thick; dextrinoid.

Gregarious to cespitose on decaying leaves and twigs, particularly of oak, in deciduous and deciduous-coniferous woods. Fruiting period: 2 Jul-14 Oct.

Collections examined:

CANADA: ONTARIO: Cain, 25 Sep 1934 (NY). UNITED STATES: CONNECTICUT: Earle, 19 Jul 1902 (NY). ILLINOIS: Shaffer 844. INDIANA: Cooke 32725, 32872; Gilliam 935; Shaffer 6354. MASSACHUSETTS: Bigelow 9696 (MASS). MICHIGAN: Gilliam 771, 772, 774, 775, 790, 832, 860, & 1313; Peters 1115; Potter 8712, 9222; Shaffer 2511; Smith 7248, 10962, 15196, 15248, & 39257. MINNESOTA: Weaver 7-7-62-P-3, 1448, & 1559. NEW YORK: Murrill, 7-17 Aug 1916 (NY); Shaffer 490. NORTH CAROLINA: Harrison 10857. OHIO: Cooke 31944 & 32917; Moldenke 13026, 13745, 13767, & 14020 (FH); Morgan, 1895 [paratype of *Marasmius delectans* Morgan (IA), here designated lectotype], 27 Aug 1905 (IA), 1905 (IA), 1906 (3 collections, IA); Overholts 1224 (NY); Stover, 2 Aug 1909 (NY). PENNSYLVANIA: Murrill, 17-21 Jul 1904 (NY), 19 Jul 1910 (NY). WISCONSIN: Sherman (NY).

None of Morgan's type specimens of *Marasmius delectans* (two collections, 1895 and 1905, both from Preston, Ohio, labelled "TYPE", and a third, from Preston, Ohio, 27 Aug 1905, annotated as "probably a type") was clearly indicated in the original description as holotype. Since the basidiocarps in the 1895 collection revive more completely than the others, it seems appropriate to designate that collection as lectotype of *M. delectans*.

Singer (41) places this species in section *Globulares*, apparently because the mature cuticle consists mostly of smooth cells with only occasional setae or irregular broom cells. However, the numerous broom cells present in the cuticle of very young pilei seems to indicate that this species belongs in section *Sicci*.

Important characters which, in combination, delimit *Marasmius delectans* are the pale yellow or yellowish white pileus; the hollow, dark, cartilaginous stipe; small (usually 6-8 µm long), obovate or ovate spores with definite apiculi; and abundant hyaline setae in the hymenium.

12. MARASMIUS COHAERENS (Persoon ex Fries) Cooke & Quélet,

Clavis Hymen. 153. 1878, var. COHAERENS

FIGS. 23 & 24

[*Agaricus cohaerens* Persoon, Syn. Meth. Fung. 306. 1801.]
Agaricus (Hebeloma) cohaerens Persoon ex Fries, Syst. Myc. 1: 253. 1821.
Agaricus ceratopus Persoon, Myc. Eur. 3: 131. 1828.
Agaricus rigidus Lasch, Linnaea 4: 531. 1829.
Mycena cohaerens (Persoon ex Fries) Kummer, Die Führer in die Pilzk. 111. 1871.
Marasmius calopus (Persoon) ex Quélet, Champ. Jura et Vosg. 222. 1872. Non *Marasmius calopus* (Persoon ex Fries) Fries, Epicr. Myc. 379. 1838.
Marasmius ceratopus (Persoon) Quélet, Fl. Mycol. France 319. 1888.

PILEUS 9-36 mm broad; campanulate or conic-convex at first, becoming convex or convex-umbonate with or without a flared margin, finally convex-depressed or plano-convex; dry or subhygrophanous, particularly on the margin; dull; opaque, or translucent on the margin in age; smooth, or sometimes rugulose on the disc; even or occasionally becoming striate up to 1/2 the pileus radius; entire; pliant or tough, the surface usually brittle; reviving. CUTICLE minutely velutinous overall at first, in age often velutinous primarily on the disc; occasionally glaucous; dark yellowish brown (Mummy Brown) or dark brown to strong brown overall at first, then dark brown, deep brown, strong brown (Amber Brown), dark yellowish brown, moderate yellowish brown (Sayal Brown), or moderate brown on the disc and often on the extreme margin, with the area in between light yellowish brown (Vinaceous-Cinnamon), light brown (Cinnamon), or moderate yellowish pink (Pinkish Buff). TRAMA thin to moderately thick (up to 1.5 mm thick in the disc); light yellowish brown, fading to yellowish white or white. ODOR lacking or somewhat pungent with an earthy component. TASTE lacking or slightly alkaline with a bitter aftertaste.

LAMELLAE moderately broad to broad (3-6 mm broad); thin; subdistant to distant; moderately numerous [12-20 (-35) reach the stipe]; unequal, with 3-4 tiers of lamellulae; adnexed, sinuate, or adnate-seceding; pliant; entire; sometimes marginate, the edges moderate brown to light brown; straight at first, soon ventricose or broadest near the stipe; faintly to strongly intervenose; not forked; yellowish white, in age moderate yellowish pink (Pinkish Buff) or rarely light brown.

STIPE 20-75 mm long, 0.75-3 mm thick; central; terete; equal, or somewhat expanded at the apex; straight or curved; dry; shining; opaque; hollow; pliant to cartilaginous, or sometimes horny in age; glabrous, or rarely white-pruinose at the apex; white, yellowish white, pale yellowish pink (Tilleul-Buff), or in age light yellowish brown at the apex, darkening progressively from the base upward through light yellowish brown, strong brown (Amber Brown), or strong yellowish brown (Ochraceous-Tawny), finally deep brown, dark brown, or blackish brown at the base. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM a tuft or pad of light yellowish brown, pale yellow, or white mycelium which may bind the surrounding debris and leaves.

SPORES white in mass; (6.0-)7.0-9.8(-11.0) X 3.0-5.5 µm; obovate, broadly subfusiform, short-clavate, pip-shaped, or broadly to narrowly elliptic. BASIDIA 21-42 X 4-8.5 µm; subclavate to clavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL SETAE 21-75(-119) X 2.5-14(-21) µm; narrowly or rarely broadly fusiform, aciculate with or without a bulbous base, lanceolate, or rarely forked; sometimes constricted abruptly 1-several times; pedicellate or not; rounded or acute apically; with light yellowish brown to moderate brown or rarely hyaline walls up to 3 µm thick; dextrinoid; projecting up to 50 µm beyond the basidioles; common or scarce on the lamellar edges and faces.

HYMENIAL BROOM CELLS 5.5-14(-22) X 3-8.5 µm; cylindric to clavate; with 2-10(-16) hyaline to pale yellow, smooth or roughened, tapered, acute projections 3-21 X 0.2-1.5 µm which are usually of unequal lengths on a single broom

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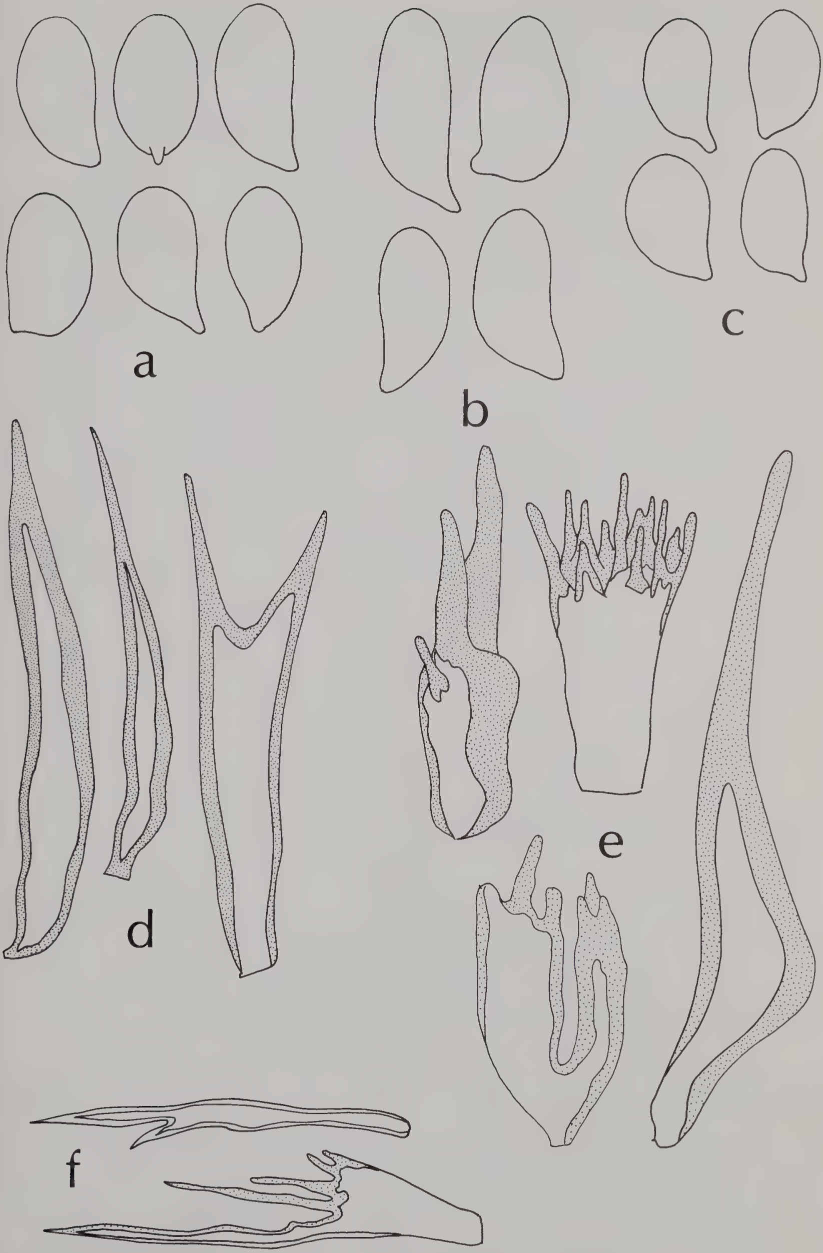
Figure 23. *Marasmius cohaerens* var. *cohaerens*. a. Spores, Ammirati 3150, x2300. b. Spores, Gilliam 1184, x2300. c. Spores, Gilliam 951, x2300. d-f. Ammirati 3150. d. Hymenial setae, x1500. e. Broom cells and setae from the pileus cuticle, x2300. f. Broom cells from the lamellar edge, x2300.


a
b
c
d
e
f

cell; with hyaline or pale yellow walls up to 1 µm thick; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated (up to 17 µm broad) in the pileus; interwoven, uninflated, and 1.5-10 µm broad in the lamellae; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of two intergrading types of cells: (1) BROOM CELLS 3-22 X 2.5-11 µm; cylindric to clavate and sometimes lobed or pedicellate; with 2-15 hyaline to dark orange yellow, smooth or roughened, rounded or acute projections 2-10(-28) X 0.5-2 µm which are often conspicuously unequal in length; with pale yellow to dark orange yellow walls up to 1(-2.5) µm thick; and (2) SETAE 10-56(-84) X 2.5-10 µm; fusoid-ventricose, narrowly lanceolate, or aciculate; with strong brown to moderate brown walls up to 2.5 µm thick; relatively abundant on the disc, rare or absent on the margin.

STIPE corticated in pigmented portions only, the cortex then 20-50 µm thick, elsewhere with the superficial hyphae hyaline and undifferentiated. CORTICAL HYPHAE 1.5-8.5(-11) µm broad; with light yellowish brown to strong brown walls up to 1.5 µm thick; dextrinoid; olive brown to greenish yellow in 2% KOH. SETAE 14-45(-70) X 4-7(-11) µm; evenly tapered to an acute apex; with light yellowish brown walls up to 2 µm thick; usually rare (scattered near the apex and absent or scattered near the base of the stipe); arising at right angles to the surface hyphae which may themselves be thick-walled for a short distance from the bases of the setae.

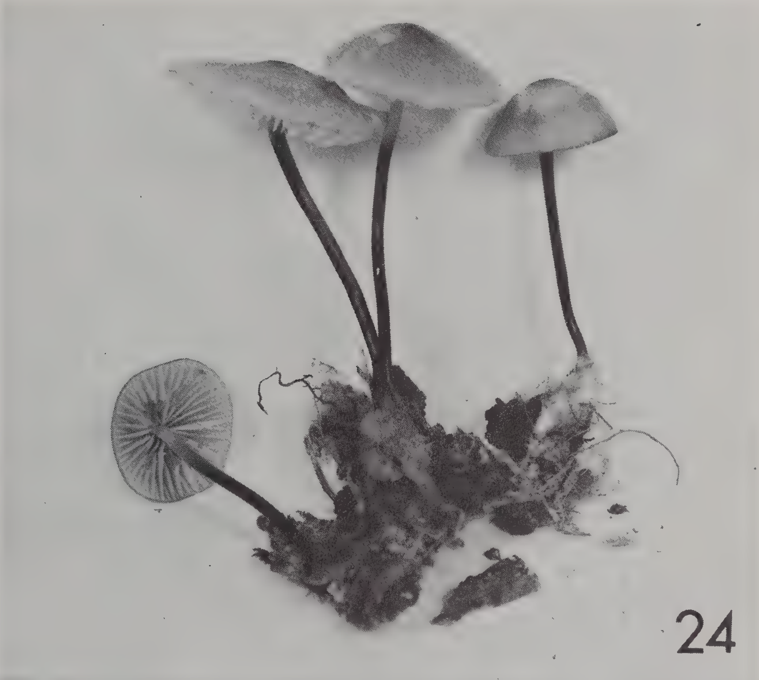
Gregarious or subcespitose on decaying leaves, twigs, and fallen logs in deciduous woods (oak-hickory, beech-maple) or hemlock forests in which deciduous trees are present. Fruiting period: 14 Jul-25 Oct.

Collections examined:

CANADA: ONTARIO: Smith 4835. QUEBEC: Bigelow 5781 (MASS). GERMANY: Shaffer 4949. UNITED STATES: MICHIGAN:

Figure 24. *Marasmius cohaerens* var. *cohaerens*. Harrison 10347, x1 (courtesy of K. A. Harrison).

Figure 25. *Marasmius cohaerens* var. *lachnophyllus*. Harrison 10541, x1 (courtesy of K. A. Harrison).



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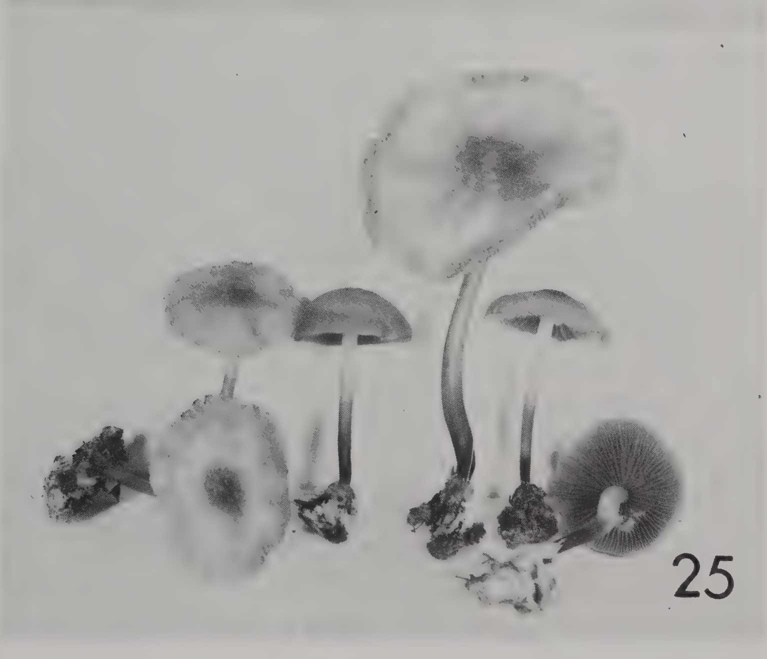

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Ammirati 3150, 4417, & 4463; Gilliam 333, 951, 1132, 1176, 1183, 1184, & 1450; Harrison 10347; Potter 3846; Shaffer 3778; Smith 10961, 63938, 71805, & 74591. NEW YORK: Murrill, 7-17 Aug 1916 (NY). PENNSYLVANIA: Kauffman, 6 Sep 1924. TENNESSEE: Hesler 10217. VIRGINIA: Stevenson, 24 Sep 1936 (BPI).

13. MARASMIUS COHAERENS (Persoon ex Fries) Cooke & Quélet, var. LACHNOPHYLLUS (Berkeley in Lea) Gilliam, stat. nov. FIGS. 25 & 26

Agaricus lachnophyllus Berkeley in Lea, Catalog of Plants of Cincinnati 77. 1849.

Agaricus (Collybia) spinulifer Peck, Annual Rep. New York State Mus. 24: 62. 1871.

Marasmius lachnophyllus (Berkeley in Lea) Morgan, J. Mycol. 11: 239. 1906.

Collybia spinulifera (Peck) Peck, Annual Rep. New York State Mus. 49: 48. 1895 (1896).

Marasmius spinulifer (Peck) Morgan, J. Mycol. 11: 238. 1906.

PILEUS (6-)11-65 mm broad; hemispheric, convex, conic-convex, or campanulate at first with an inrolled or incurved margin, soon broadly convex, broadly conic, or plano-umbonate, finally almost plane with the margin uplifted; moist or subhygrophanous in basidiocarps with thin flesh and then fading in a subzonate pattern, finally dry; dull; opaque, or rarely translucent on the margin; smooth, or often cracked on the disc in age; even; entire or lobed; tough, but easily cracked on the surface when bent; reviving. CUTICLE minutely to conspicuously velutinous primarily on the disc; often with a white bloom at first; when moist and young deep brown (M&P 8H12), dark yellowish brown, deep yellowish brown, strong brown (Amber Brown, Antique Brown, M&P 7C12, 14A11, 14C12, 15A12), moderate yellowish brown (M&P 13G8), or moderate brown (Mars Brown, Cinnamon Brown, Brussels Brown, M&P 15A10-11), paler on drying or expansion and then the disc and extreme margin these same colors or light brown (Cinnamon, M&P 13C-D12), brownish orange (Tawny), dark grayish brown (M&P 16A10), or rarely blackish brown, and the region between the disc and extreme margin light yellowish brown (Pinkish Cinnamon, M&P 11B5-6), dark orange yellow (Ochraceous-Tawny), pale orange yellow (M&P 9C3, 9D4), brownish orange (M&P 13D12), or light yellowish pink (M&P 10B4, Pinkish Buff). TRAMA thin to moderately thick (0.5-4 mm thick in the disc);

light yellowish brown when young and moist, soon white or yellowish white. ODOR nondescript or faintly nitrous. TASTE mild to alkaline or sometimes bitter and astringent.

LAMELLAE narrow (up to 2 mm broad), sometimes broader in age; close or rarely crowded (18-50 reach the stipe); unequal, with 2-8 tiers of lamellulae; usually adnexed or sinuate, sometimes adnate, seceding, or almost free; pliant; entire, minutely fimbriate, or crenate; with the edge straight at first, broadest near the stipe in age; faintly to strongly intervenose; rarely forked near the stipe; light brown, light yellowish brown (Vinaceous-Cinnamon, Pinkish Cinnamon, M&P 11B4-6, 11D6, 12B3), pale orange yellow (M&P 10B2), or moderate yellowish pink (Vinaceous-Buff, Light Pinkish Cinnamon), when young often appearing moderate brown or deep brown from below as a result of reflection from setae on the lamellar faces, often moderate brown on the margins.

STIPE 11-65(-100) mm long, 0.75-5.0(-8.0) mm broad; central or slightly eccentric; terete at first, then compressed laterally; equal or tapered slightly to the base; straight or curved, often twisted; dry; shining when moist; opaque; hollow; cartilaginous to horny; even; finely and minutely pruinose to pubescent overall or nearly glabrous; pale orange yellow (M&P 10B-C2), light yellowish brown (M&P 11B2, 11C4, 12B5, 13C10), light brown, or moderate yellowish brown (M&P 14K7) above, centrally dark orange yellow (M&P 10G7), strong brown (M&P 7A11), moderate olive brown (M&P 13K7, or strong yellowish brown (Buckthorn Brown), with the base moderate brown, deep brown, or blackish brown, darkening progressively upward with age. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM of appressed or cottony white hairs which often stain pale yellow or may become pale orange yellow overall; usually uniting the bases of several stipes and sometimes forming an extensive compact or spongy pad.

SPORES white in mass; (5.5-)6.0-8.5(-9.1) X 3.0-4.5 µm; narrowly to broadly elliptic, fusoid-elliptic, obovate, or pip-shaped. BASIDIA 21-35 X 4-8 µm; subclavate to clavate; 4- or rarely 2-spored. BASIDIOLES subfusiform.

HYMENIAL SETAE (11-)35-120 X 4-24 µm; usually fusoid-ventricose and abruptly or evenly tapered to a long narrow neck, sometimes broadly clavate, ovate, fusiform, subulate or aciculate, rarely diverticulate at the base, forked up to 1/3 the length of the apex, or with 2-3 short knoblike or pyramidal appendages and then resembling broom cells; often pedicellate; acute, mucronate, or rounded apically; with light yellow to deep brown or rarely hyaline walls up to 3 µm thick; empty or with oily or granular particles which disappear in 2% KOH; projecting conspicuously (up to 78 µm beyond the basidioles); present on the edges and faces of the lamellae.

TRAMAL HYPHAE interwoven, often inflated, and 1.5-14 µm broad in the pileus; parallel to interwoven, occasionally inflated, and 2.5-12 µm broad in the lamellae; with thin, hyaline to light yellowish brown walls; dextrinoid.

PILEUS CUTICLE hymeniform; in primordia composed entirely of setae, later with the setae separated by broom cells or smooth cells. SETAE 33-103 X 3-10(-16) µm; tapering gradually or abruptly upward from a fusiform or elliptic base, or fusiform to cylindric and often pedicellate; with strong brown walls up to 3 µm broad; often arising deep in the trama. BROOM CELLS 4-28 X 3-11(-14) µm; cylindric, obovate, or subglobose and often lobed, branched, or pedicellate; with 4-25 smooth or rough, usually tapered, divergent, acute or rounded, hyaline to dark orange yellow projections 2-14 X 0.5-2 µm; with hyaline to deep brown walls 0.5-2 µm thick; often accompanied by cells intermediate between broom cells and setae. SMOOTH CELLS 4-11(-13) X 3-11 µm; cylindric, clavate, or subglobose; with hyaline walls up to 2 µm thick.

STIPE corticated in the pigmented portions only, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 1-14 µm broad; with strong brown walls up to 2 µm thick; dextrinoid; greenish yellow in 2% KOH. TRAMAL HYPHAE 1-11 µm broad; with hyaline walls up to 1 µm thick; dextrinoid. SETAE 19-140 X 5.5-14 µm; usually tapered from a broad, flat base but sometimes knoblike, diverticulate at the base, pyramidal, or fusiform, or rarely with 1-several apical projections and then resembling broom cells; with light yellowish brown to deep brown walls 0.5-2 µm thick; dextrinoid; scattered or clustered; usually abundant overall, sometimes rare near the base.

Gregarious to cespitose on rotted hardwood logs or woody debris in deciduous or deciduous-coniferous woods. Fruiting period: 4 Jun-2 Oct.

Collections examined:

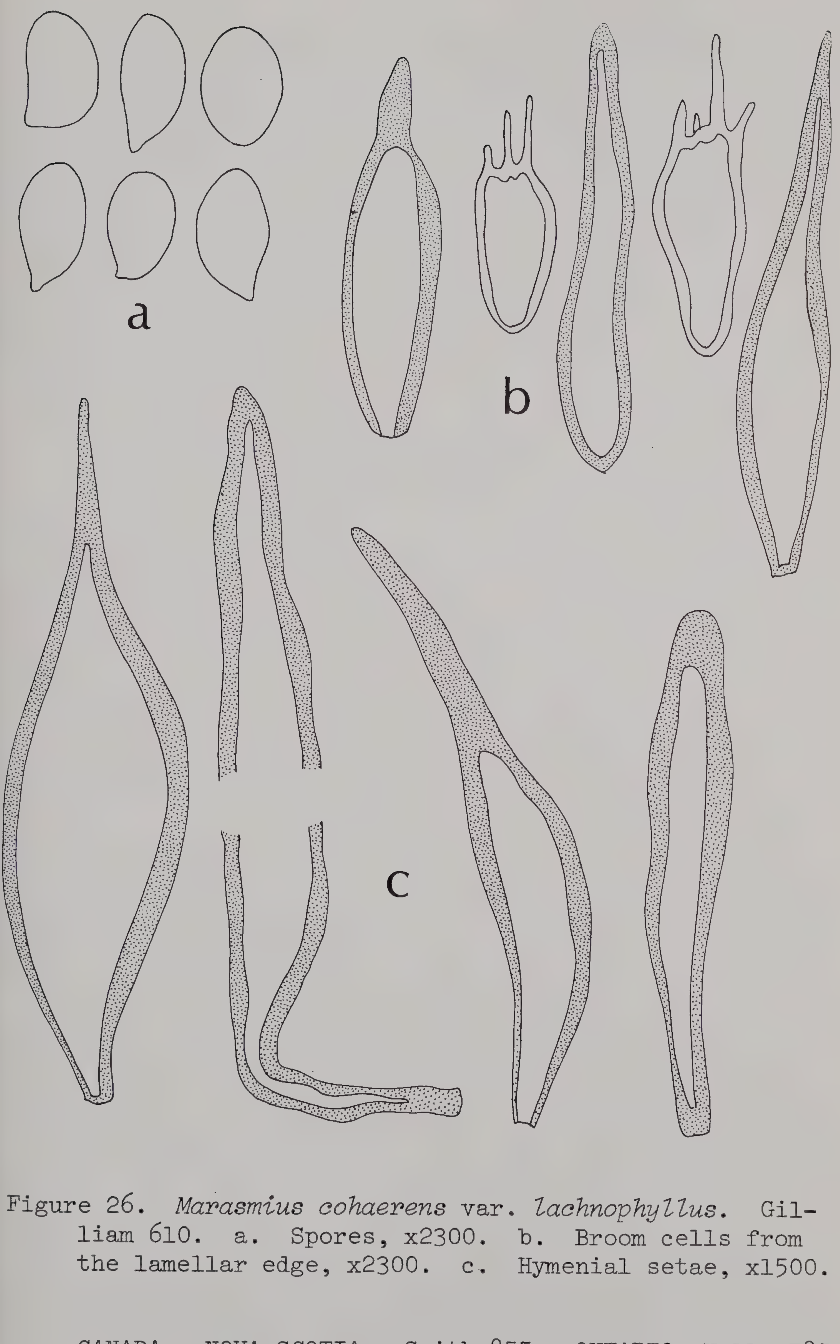


Figure 26. *Marasmius cohaerens* var. *lachnophyllus*. Gilliam 610. a. Spores, x2300. b. Broom cells from the lamellar edge, x2300. c. Hymenial setae, x1500.

CANADA: NOVA SCOTIA: Smith 855. ONTARIO: Kelly 785.

UNITED STATES: MAINE: Bigelow 10098 (MASS). MASSACHUSETTS: Bigelow 7743 (MASS). MICHIGAN: Ammirati 2477 & 4954; Gilliam 355, 356, 357, 560, 570, 593, 610, 620, 629, 839, 1144, 1169, 1185, & 1186; Harrison 10541, 10566; Patrick 1518; Potter 3945; Shaffer 2775; Smith 6323, 15141, 21597, 36499, 39492, 39536, 51198, 61479, & 63758. MINNESOTA: Weaver 1562. NEW HAMPSHIRE: Bigelow 12241 (MASS), 12418 (MASS). NEW YORK: Peck, Sep (holotype of *Agaricus (Collybia) spinulifer* Peck (NYS); Singer 171 (FH); Smith 421 & 544. NORTH CAROLINA: Harrison 11214, 11227, & 11424. OHIO: Curtis, 5 Sep 1844 (holotype of *Agaricus lachnophyllus* Berkeley in Lea, K). TENNESSEE: Hesler 14180; Smith 10549. VIRGINIA: Shear, 17 Jun 1897 (BPI).

Although several other characters correlate fairly well to distinguish *Marasmius cohaerens* var. *cohaerens* from *M. cohaerens* var. *lachnophyllus*, the two taxa are here primarily differentiated on the basis of broad, distant lamellae in the former and narrow, close lamellae in the latter. I have seen the type of *Agaricus lachnophyllus* Berkeley in Lea, on which the latter variety is based; it has narrow, close lamellae as well as the other features discussed below as characteristic of the taxon. The type of *Agaricus (Collybia) spinulifer* Peck, which I have also seen, belongs to the same taxon. *M. cohaerens* var. *lachnophyllus* is the predominant variety in North America. The type of *M. setulosus* Murrill (NY), suggested by Singer (39) as a possible synonym of *M. cohaerens*, does not seem to be conspecific.

I have considered the broad, distant-gilled taxon in North America to be the same as the European *Marasmius cohaerens*. The type of *Agaricus cohaerens* Persoon, which according to Singer (39) is not available, had distant lamellae. Certainly the descriptions and illustrations by Persoon, Fries, and other European mycologists suggest a fungus similar to the broad, distant-gilled form in North America, although the stipes of the basidiocarps in North America are generally shorter than those of European specimens. Since the European types of taxa with broad, distant lamellae were not available, I have followed Quélet (26, 27) and Singer (37) in synonymizing *Agaricus ceratopus* Persoon and Singer (39) in synonymizing *A. rigidus* Lasch. The best preserved European specimen of var. *cohaerens* that I have seen (Shaffer 4949) lacks the zonation of the pileus so characteristic of North American material but agrees in having large spores and short, narrow hymenial setae.

Variation in *Marasmius cohaerens* as a whole can be traced to three separate factors. The degree of expansion of the pileus usually accounts for the wide variation in cell composition of the cuticle, which may at first seem to be a taxonomic indicator. A second variational parameter is that of seasonal change. In *M. cohaerens* var. *lachnophyllus* June fruitings tend to be weak, with few, relatively small, often gregarious basidiocarps, as is the case with many fungi fruiting over a long period. From mid-July to early August large, strongly cespitose forms predominate. In September and October both size and number of basidiocarps are more variable. While yellowish brown and pinkish brown colors occur more frequently in the summer, orange brown colors prevail in fall fruitings. A third group of variations seems relatively independent of seasonal or developmental factors. These are the characters used to separate var. *lachnophyllus* from var. *cohaerens:*

Character	*M. cohaerens* var. *cohaerens*	*M. cohaerens* var. *lachnophyllus*
Lamellar breadth	broad	narrow
Lamellar spacing	subdistant to distant	close
Spore size	(5.9-)7.0-9.8(-11) x 3.0-5.5 µm (long and broad)	(5.5-)6.0-8.5(-9) x 3.0-4.5(-5) µm (short and narrow)
Size of hymenial setae	21-75(-119) x 2.5-14(-21) µm	(11-)35-120 x 4-24 µm
Presence of broom cells on lamellar edge	usually present	usually absent
Frequency of setae on stipe	rare	abundant
Habitat	usually on leaves or humus	usually on hardwood logs or twigs

Exceptions to the character state groupings above occur occasionally. For example, Gilliam 1169 has narrow, close to subdistant lamellae (and is therefore placed with var. *lachnophyllus)* but is otherwise similar to broad, distant-gilled specimens. Several collections with narrow, close lamellae have broad spores (e.g., Harrison 10566, Smith 21597, Gilliam 629) or long spores (Gilliam 629, Gilliam 1144, Smith 544). Basidiocarps with broad, distant lamellae (var. *cohaerens)* may have short, narrow spores (Gilliam 1132, Gilliam 951) or long, narrow spores (Smith 63938).

14. MARASMIUS SULLIVANTII Montagne, Syll. Crypt. 143. 1856. FIGS. 27-30

PILEUS 6-25 mm broad; at first pulvinate or convex with an incurved margin, becoming broadly convex to plano-convex and often subumbonate; dry; dull; opaque, or rarely translucent on the margin; smooth; even, or sometimes faintly striatulate in age; entire; pliant; reviving. CUTICLE minutely velutinous; at first with a whitish bloom; brilliant orange, deep orange (Orange-Rufous), moderate reddish orange (Ferruginous), or strong brown (Sanford's Brown, Hazel) at first, usually with the margin paler than the disc, in age strong yellowish brown on the disc and dark orange yellow on the margin, in dried basidiocarps strong brown to deep brown, often with minute pale yellow spots near the margin. TRAMA thin (up to 1.5 mm thick), tapering abruptly to the margin; nearly white. ODOR lacking. TASTE slowly bitter or sometimes lacking.

LAMELLAE narrow to moderately broad (up to 1-3 mm broad); thin; close, or rarely crowded; moderately numerous (18-20 reach the stipe); unequal, with numerous lamellulae in several tiers; adnexed to free; membranous; entire; broadest near the stipe, narrowing abruptly in front; not intervenose; not forked; nearly white (M&P 9B1-2) or light pink, often with moderate brown or light pink edges.

STIPE 10-60 mm long, 1-2 mm thick; central; terete; equal or enlarged at the apex or base; usually curved; dry; shining; opaque; hollow; cartilaginous; even; minutely pruinose or pubescent at the apex and mid-portion, strigose to tomentose near the base, the hairs white or nearly so; white to pale orange yellow or rarely tinged pink at the apex and almost overall when young, darkening below through strong yellowish brown or strong brown to deep brown, occasionally grayish red or blackish brown at the base. STERILE STIPES and RHIZOMORPHS lacking. BASAL MYCELIUM abundant and conspicuous on the surrounding substrate, often binding several leaves together; white, drying pale orange yellow.

SPORES white in mass; 6.7-8.4(-9.5) X 2.8-3.5(-4.5) µm; pip-shaped, narrowly elliptic, narrowly fusoid-elliptic, ovate, or narrowly obovate. BASIDIA 17-30 X 4-7 µm; subclavate to clavate; 4-spored. BASIDIOLES subclavate to subfusiform.

HYMENIAL CYSTIDIA 16-38 X 3-7 µm; cylindric, subclavate, or narrowly fusiform; subcapitate, submoniliform, short- to long-appendiculate, or if not, then rounded apically; with thin, hyaline walls; nonamyloid; scarcely projecting; rare to abundant on the edges and faces of the lamellae.

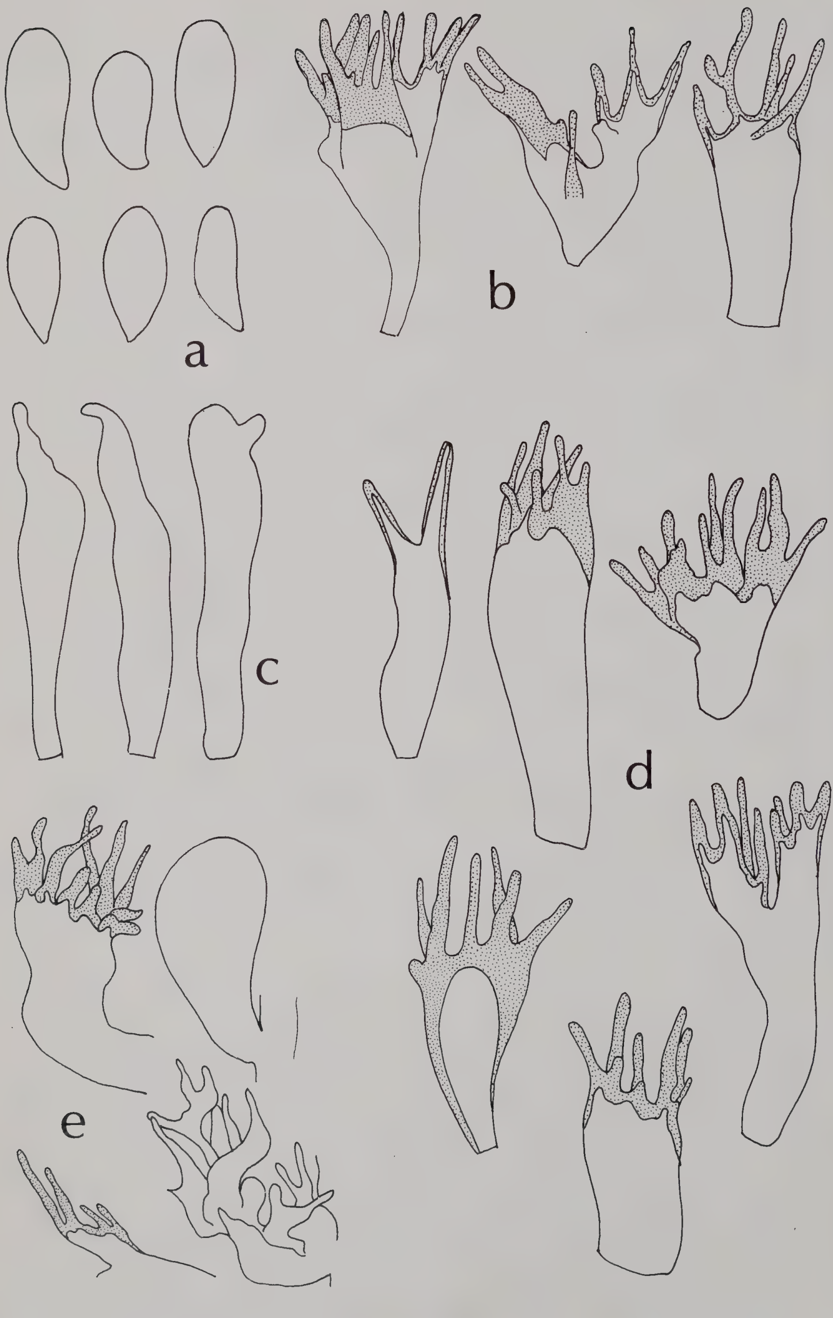
HYMENIAL BROOM CELLS 4-25 X 2-7 µm; clavate, cylindric, or deltoid; with 2-8(-15) hyaline to pale orange yellow, rodlike projections 5-11(-15) X 0.5-1.0 µm, which are tapered, smooth or wavy in outline, dextrinoid or nonamyloid, and usually divergent; with hyaline to pale orange yellow walls up to 1 µm thick; abundant on the lamellar edges.

TRAMAL HYPHAE pseudoparenchymatous and inflated up to 14 µm broad in the pileus; parallel, uninflated, and 2-7 µm broad in the lamellae; with thin, hyaline walls; dextrinoid (deep brown in Melzer's reagent, slowly becoming moderate red).

PILEUS CUTICLE a hymeniform layer of clavate, cylindric, or deltoid, often basally constricted or broadly pedicellate broom cells 5. 5-21 X 2.6-7(-12) µm, with 2-14 moderate orange yellow, divergent, smooth, occasionally branched, dextrinoid or nonamyloid rodlike projections 4.2-15 X 0.5-1.5 µm; with hyaline to light yellowish brown walls up to 1 µm thick.

STIPE corticated only in pigmented portions, the surface hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 2-7 µm broad; with pale orange yellow to strong brown walls up to 2 µm thick; dextrinoid. TRAMAL HYPHAE 2-14 µm broad; with thin, hyaline walls or with the wall occluding the lumen; dextrinoid. STIPE VESTURE (at apex and midportion of the stipe) of two intergrading types of cells: (1) irregular broom cells with numerous hyaline to pale yellow, often branched projections, and (2) cylindric to clavate or lobed hairs 3-8.5 µm broad.

Gregarious or occasionally joined in pairs on leaves of deciduous trees, acorns, and nutshells in deciduous


a
b
c
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e

and deciduous-coniferous woods. Fruiting period: 15 Jun-6 Sep.

Collections examined:

ILLINOIS: Shaffer 842. INDIANA: Cooke 32715 & 32833; Gilliam 938. MAINE: Murrill, 2-6 Sep 1905. MARYLAND: Stevenson 759 (BPI). MASSACHUSETTS: Bigelow 8194 (MASS), 9599 (MASS), & 15505 (MASS). MICHIGAN: Hoseney 1254. MINNESOTA: Weaver 6-20-62-N-1 & 1180. NEW YORK: House, 22 Jul 1945 (NYS); Atkinson (NYS). NORTH CAROLINA: Harrison 10909 & 10980. OHIO: Lloyd 27933 (BPI); Cooke 31920, 35695, & 35792. TENNESSEE: Smith 9715 & 10234. VIRGINIA: Kauffman, 20 Aug 1918; Murrill, 16-30 Jul 1920 (NY).

Both Kauffman and Morgan recognized this taxon, but both called it *Marasmius erythropus* Fries and considered it either identical to European material of the species or a distinct American variety. The colors of *M. erythropus* in Fries' *Icones* (Vol. 2, *t. 172, f. 2*) are similar to those of *M. sullivantii*, but a thick, hairy stipe is definitely figured and the stipe of *M. sullivantii* is thin and pruinose rather than hairy. Fries' description of *M. erythropus* (Epicr. Myc. 387. 1838) suggests a close relationship between it and *Collybia confluens* Fries. Although I cannot be certain of its correct determination, an exsiccati specimen of *M. erythropus* from Europe [Herpell (NY)] also indicates that that species rightly belongs in *Collybia* and that *M. erythropus* is not the correct name for the taxon described above.

The type of *Marasmius sullivantii* was originally at Paris but apparently is no longer available. The species described above is common in the part of its range from which Sullivant sent the type of *M. sullivantii* to Montagne and fits Montagne's original description. The use of the name for this taxon was first suggested to me by a specimen at BPI (Lloyd 27933) determined by Lloyd, who had worked

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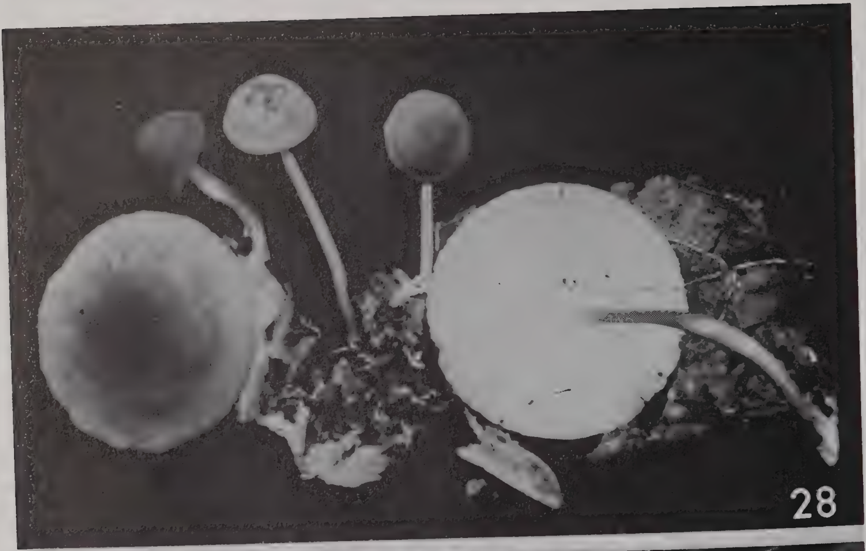
Figure 27. *Marasmius sullivantii.* Gilliam 938. a. Spores, x2300. b. Broom cells from lamellar edge, x2300. c. Hymenial cystidia, x1500. d. Hyphal ends and broom cells from stipe, x2300. e. Broom cells from pileus cuticle, x2300.



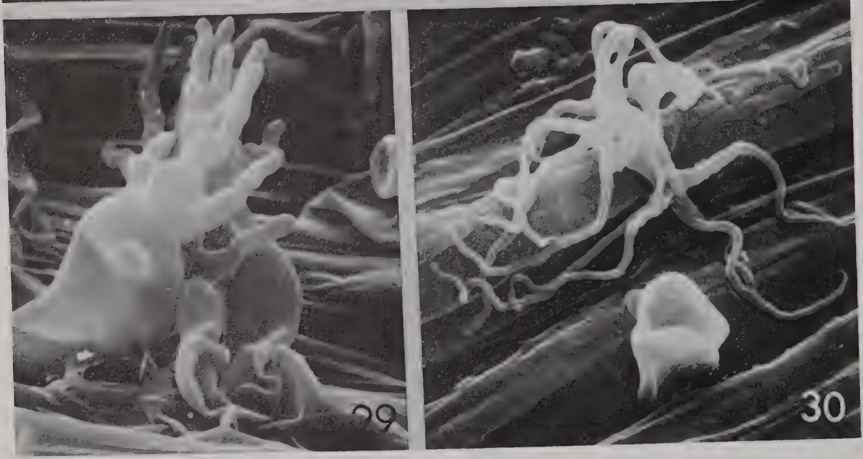


Figure 28. *Marasmius sullivantii*, x approximately 1-1/2. (courtesy of Richard Homola)

Figures 29 & 30. *Marasmius sullivantii*. Gilliam 938. Scanning electron micrographs of broom cells from the stipe surface, x4000 (courtesy of Larry Allard) in Paris.

Like *Marasmius glabellus*, *M. sullivantii* often has a a smooth (nonstriate and nonsulcate) pileus and a pallid stipe when young; as a consequence, specimens of *M. sullivantii* have often been misidentified as *M. glabellus*. The most prominent differences between the two are presented below:

Character	*M. sullivantii*	*M. glabellus*
Pileus color	brilliant orange, moderate reddish orange, strong brown	deep yellowish brown to pale orange yellow
Pileus striation	rarely more than faintly striatulate	usually distantly striate in age
Lamellar spacing	close to crowded	distant
Spore size	6.7-8.4(-9.5) x 2.8-3.5(-4.5) µm	(5.9-)7.0-11.2 x 3.1-6.0 µm
Stipe vesture at apex and mid-portion	broom cells and smooth clavate cells	none except at stipe base
Basal mycelium	abundant on surrounding substrate	not conspicuous on substrate

15. MARASMIUS ARMENIACUS Gilliam, Mycologia 67: 837. *f. 29-32.* 1975.

PILEUS 2-6 mm broad; pulvinate at first, then convex, umbonate, or nearly plane; dry; dull; opaque; smooth at first, becoming minutely rugulose or rugulose-striate; not plicate or striate; entire; membranous; pliant; probably not reviving. CUTICLE minutely velutinous; sometimes whitish-pruinose; moderate orange (M&P 11B8 at first, then 11A12). TRAMA thin (not measurable). ODOR lacking. TASTE bitter, with a spermatic aftertaste.

LAMELLAE narrow (less than 0.2 mm broad); thin; distant to remote; moderately numerous (12-14 reach the stipe); unequal, with 2 tiers of short lamellulae which alternate with the lamellae, or in young basidiocarps sometimes equal; adnate or sometimes attached to a partial adnate collar; membranous and fragile; entire; straight; sometimes faintly intervenose; occasionally forked in front; yellowish white (M&P 9B2).

STIPE short (2-12 mm long), 0.1-0.2 mm thick; slightly eccentric; filiform; equal; curved; moist; subshiny; opaque except at the apex; solid; fragile, soon collapsing; even; minutely pubescent overall, the hairs white, yellowish white, or pale yellow; translucent and colorless overall at first or sometimes yellowish white, later white at the apex and brownish orange (M&P 11D8) at the base; insititious. STERILE STIPES numerous; arising individually at intervals along the substrate; with tapered to acute apices; yellowish white. RHIZOMORPHS and BASAL MYCELIUM absent.

SPORES white in mass; 7.1-9.0 X 3.1-4.4 µm; narrowly to broadly elliptic, fusoid-elliptic, or obovate. BASIDIA 18.2-20.3 X 5-5.5 µm; subclavate to clavate; 4-spored. BASIDIOLES subclavate to fusiform.

HYMENIAL CYSTIDIA lacking.

HYMENIAL BROOM CELLS 9.8-16.8 X 4.2-7.0 µm; narrowly to broadly cylindric, fusoid-elliptic, fusoid-ventricose, or elliptic; with apical incrustations or projections which are finely and indistinctly divided and diffuse, or occasionally with 1-several discrete, rodlike projections up to 4 µm long; with thin, hyaline to pale yellow walls; dextrinoid; present only on the lamellar edges.

TRAMAL HYPHAE 2-8 µm broad; uninflated and interwoven in the pileus; uninflated and parallel in the lamellae; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of truncate-clavate, cylindric, or subglobose, or sometimes deeply 2-lobed broom cells 2.8-14 X 3.5-8.4 µm with indistinctly divided and branched or rarely rodlike projections up to 6 µm long and hyaline to light yellow walls up to 1 µm thick.

STIPE corticated only in pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 4-6 µm broad; with pale yellow walls up to 0.5 µm thick; dextrinoid. TRAMAL HYPHAE with thin walls but otherwise similar to the cortical hyphae. STIPE VESTURE abundant overall, of three cell types: (1) cylindric to clavate or irregular broom cells with numerous knoblike, rounded, or rodlike projections 2-8 µm long and thin, hyaline to pale yellow walls; (2) modified broom cells with cylindric to clavate bases, with 1-6 tapered, threadlike extensions up to 50 µm long and hyaline walls up to 2 µm thick; and (3) tapered, clavate, or ovate, refractive smooth hairs with hyaline to pale yellow walls up to 2 µm thick, rarely septate.

On dead grass culms on a limestone outcropping with mixed low conifers and grassland plants. Fruiting period: unknown (23 Aug).

Collection examined:

INDIANA: Gilliam 932a (holotype of *Marasmius armeniacus* Gilliam).

Marasmius armeniacus is atypical of species in section *Sicci*, particularly in lacking well-defined basal mycelium. It has been placed here because the trama is dextrinoid, the lamellae are collarless, and the stipe bears *siccus*-like broom cells. For a further discussion, see Gilliam (8).

16. MARASMIUS SPISSUS Gilliam, Mycologia 67: 834. *f. 24-28.* 1975.

FIG. 32

PILEUS 10-50 mm broad; at first obtusely conic to convex with an incurved margin, becoming plane or broadly plano-umbonate, in age with the margin uplifted; moist and subhygrophanous; dull; opaque; smooth; not striate or only faintly so on the margin; entire; firm. CUTICLE glabrous; light yellowish brown (Pinkish Cinnamon) to moderate yellowish pink (Light Pinkish Cinnamon), paler on the margin in age. TRAMA moderately thick (1.5-2 mm thick); watery light grayish yellowish brown (Avellaneous) when moist, drying yellowish white. ODOR and TASTE mild.

LAMELLAE narrow (about 1.5 mm broad); thin; crowded; numerous (more than 50 reach the stipe); unequal, with few lamellulae; adnexed; entire; straight; forked or anastomosed; white at first, soon light grayish yellowish brown (Avellaneous).

STIPE 30-60 mm long, 3-4 mm thick; central; terete or compressed; equal or enlarged at the base; dry; shining; opaque; hollow; cartilaginous to horny; even; glabrous; light yellowish brown at the apex, brownish orange to moderate reddish brown (Chestnut) at the base. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM forming a pad at the base and adhering to the substrate; yellowish white, pale yellow, or brownish orange.

SPORES 5.2-8.5 X 2.6-3.4 µm; narrowly elliptic or narrowly pip-shaped. BASIDIA 14-24 X 3-6.5 µm; subclavate to clavate; 4-spored. BASIDIOLES subclavate to subfusiform.

HYMENIAL CYSTIDIA 19-35 X 4-14 µm; clavate, subcylindric, or lobed; capitate, or rounded to acute apically; with hyaline walls up to 0.5 µm thick; projecting up to 5 µm beyond the basidioles; rare on the lamellar faces and edges.

HYMENIAL BROOM CELLS 13-32 X 3-11 µm; clavate, fusoid-clavate, subcylindric, or lobed; with 2-8 lateral or apical hyaline or rarely pale yellow, nonamyloid projections up to 4 X 0.5 µm; with hyaline walls up to 0.5 µm thick; nonamyloid; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated up to 13 µm in the pileus; parallel-interwoven, uninflated, and 2-8 µm broad in the lamellae; with hyaline walls up to 1 µm thick; dextrinoid.

PILEUS CUTICLE a hymeniform layer of cylindric to subclavate or subglobose broom cells 5-28 X 4-10 µm, with 6-15(-20) pale orange yellow to moderate orange yellow, smooth or roughened, rounded projections 4-11 X 0.5-1.5 µm, with pale orange yellow walls up to 0.5(-1) µm thick.

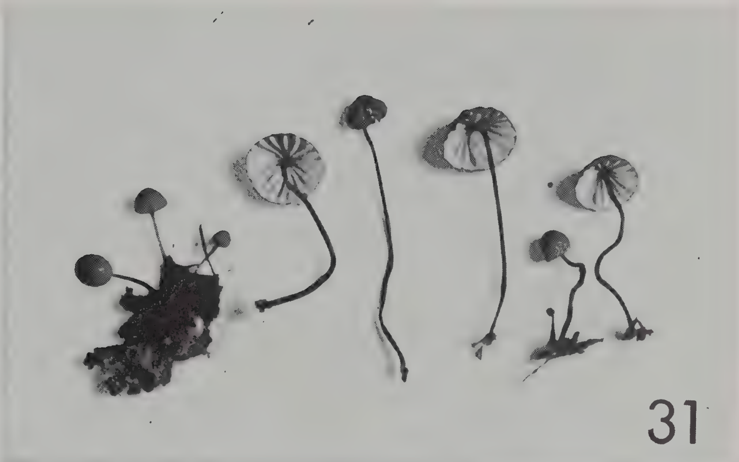
STIPE corticated thinly overall. CORTICAL HYPHAE 3-7 µm broad; with pale orange yellow walls up to 1 µm thick; dextrinoid. TRAMAL HYPHAE up to 11 µm broad; with hyaline walls up to 0.5 µm thick; dextrinoid. STIPE VESTURE of clavate, slightly projecting hyphal ends and rare to moderately abundant, irregularly shaped, hyaline broom cells with projections to 20 µm long; abundant near the stipe base, rare elsewhere.

Solitary, gregarious, or cespitose on leaves in deciduous woods. Fruiting period: 2 Jul-17 Sep.

Collections examined:

INDIANA: Gilliam 938a. MICHIGAN: Smith 15426 & 62486 (holotype of *Marasmius spissus* Gilliam).

For a discussion of the differences between this species and *Marasmius sullivantii* Montagne, see the original publication of *M. spissus* (8). Numerous collections from North Carolina which probably belong to this taxon have not been included because they have no notes on macroscopic features and recognition of this species is not possible through microscopic characters alone.



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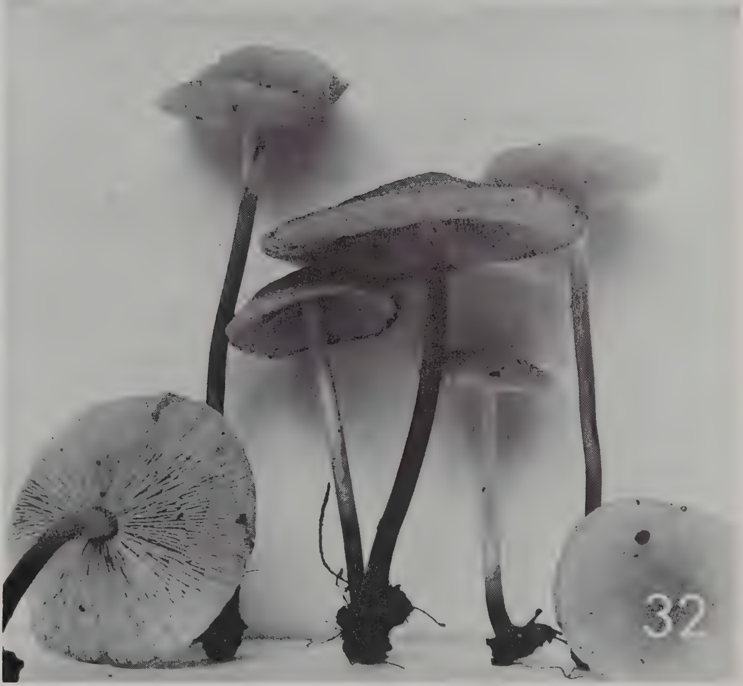

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Figure 31. *Marasmius borealis*. Gilliam 1188, x1.

Figure 32. *Marasmius spissus*. Smith 62486, x1 (courtesy of A. H. Smith).

17. MARASMIUS BOREALIS Gilliam, Mycologia 67: 831. *f. 21-23.* 1975.

FIG. 31

PILEUS 4-23 mm broad; pulvinate, conic-convex, or convex-umbonate at first, then conic to broadly campanulate, finally convex to plano-convex and umbonate or not; dry; dull; opaque; smooth almost until maturity, then rugose-reticulate on the disc and rugulose on the margin; even or in age shallowly sulcate 2/3-7/8 the pileus radius; entire, becoming crenate in age; tough-membranous; reviving. CUTICLE minutely velutinous; deep red (Garnet Brown), brownish orange, or strong brown (M&P 14A12) in primordia, then deep orange (Orange-Rufous), light brown, moderate orange (M&P 12G7), strong orange yellow (Capucine Yellow), moderate orange yellow (Orange-Buff), or pale orange yellow (M&P 9G6), sometimes with the disc brownish orange to strong brown (M&P 12C-E12), drying pale orange yellow to light yellowish brown. TRAMA thin (up to 1 mm thick in the disc, scarcely discernible 1 mm outward from the center); pliant; white to yellowish white, or purplish pink around the point of attachment of the stipe. ODOR of crushed pilei fragrant, somewhat like that of *Pleurotus ostreatus*. TASTE mild, with an alkaline aftertaste.

LAMELLAE narrow (up to 1.5 mm broad in an old pileus 12 mm broad); thin; distant; moderately numerous (15-20 reach the stipe); equal; ascending-adnate or adnexed; membranous and pliant; entire; straight at first, sometimes becoming ventricose; crisped upon drying; intervenose or not; not forked; yellowish white.

STIPE 10-60 mm long, 0.3-0.9 mm thick; central; terete, but soon collapsed and flattened; equal or tapering slightly to the apex; straight or curved; dry; shining; opaque; hollow; flexible at first, then broomstraw-like (not wiry); even; glabrous; dark red, grayish red, or moderate purplish red overall at first and later on the apex only, the basal portion becoming moderate brown (M&P 15E12) to dark grayish brown progressively upward. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM of cottony white hairs; not forming a distinct pad on the substrate.

SPORES white in mass; (9-)12.6-16.8(-17.5) X 2.9-4.5 µm; curved-clavate, clavate, or fusoid-elliptic. BASIDIA (21-)28-44 X 4.2-8.5 µm; clavate or subclavate; 4-spored. BASIDIOLES fusiform, often with constricted apices.

HYMENIAL CYSTIDIA lacking.

HYMENIAL BROOM CELLS 7-21 X 3-7 µm; cylindric, narrowly to broadly clavate, or rarely obovate; with (2-)6-15 hyaline to pale yellow, sometimes branched, roughened, delicate knoblike or rodlike dextrinoid projections 1.1-5.5(-7) X 0.2-1.0 µm; with hyaline walls up to 0.5 µm thick; present only on the lamellar edges.

TRAMAL HYPHAE 4-7 µm broad in both pileus and lamellae; interwoven; uninflated; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of cylindric to clavate or lobed (always longer than broad) and sometimes indistinctly pedicellate broom cells 5.5-40 X 2.5-8.5 µm; with (4-)10-20 finely divided and indistinct or sometimes rodlike, rounded or acute, hyaline to pale orange yellow or rarely dark orange yellow, often knobby or roughened projections 2.8-5.6 X 0.8-1.5 µm, with hyaline walls up to 0.5 µm thick.

STIPE corticated overall. CORTICAL HYPHAE 3-7 µm broad; hyaline, pale yellowish pink, or pale purplish pink (the pigment cytoplasmic); with purplish pink to light yellowish brown walls up to 1 µm thick, or with pale yellow walls occluding the lumen; dextrinoid; dark grayish olive in 2% KOH. TRAMAL HYPHAE 2.8-5.5 µm broad; hyaline to rarely pale pink (the pigment cytoplasmic); with thin, hyaline walls; dextrinoid. VESTURE (at extreme apex of stipe only) of rare, pale purplish pink or pale orange yellow broom cells with strongly reduced or obsolescent basal portions and up to 10 irregular projections 0.2-7 X 0.5-1 µm.

On decayed leaves of deciduous trees in hardwood or mixed deciduous-coniferous woods. Fruiting period: 3 Jul-2 Sep.

Collections examined:

CANADA: QUEBEC: Bigelow 5398 (MASS), 5583 (MASS), 5773 (MASS), & 5775 (MASS); Smith 61779. UNITED STATES: MAINE: Bigelow 3098 (MASS), 3249 (MASS), 3507 (MASS), 10245 (MASS), & 10305 (MASS). MICHIGAN: Ammirati 1865 & 4628; Gilliam 1171 & 1188 (holotype); Harrison 10307 & 10528; Kauffman, 3 Jul 1905; N. J. Smith 1877; Thiers 991 & 3892. NEW HAMPSHIRE: Bigelow 12115 (MASS); Singer, 25-26 Jul 1941 (FH). NEW YORK: Bigelow 5088 (MASS). VERMONT: Bigelow 12984 & 12985 (MASS).

18. MARASMIUS FULVOFERRUGINEUS **Gilliam, sp. nov.**

FIGS. 33 & 34

Pileus 19-45 mm latus, ex campanulato vel hemisphaerico convexus, deinde umbonatus, plicatulus, tenaci-membranaceus, cinnamomeus, fulvo-ferrugineus vel brunneo-aurantius. Odor et sapor farinacei. Lamellae latae, tenues, distantes, modice numerosae (23-28), aequales, liberae, membranaceae, eburneae. Stipes 54-80 mm longus, 1-1.25 mm crassus, aequalis, nitidus, corneus, glaber, apice roseus, base castaneus vel atrobrunneus. Mycelium basale album. Sporae 15.2-18 X 3-4.5 µm, clavatae vel fusoideo-clavatae. Cystidia hymenii nulla vel rara, hyalina, 38-42 X 6-8 µm. Echinidia hymenii 8-18 X 8-12 µm, cylindrica, cum 8-25 projecturis hyalinis vel luteolis 2-8 X 1-3 µm. Trama pilei dextrinoidea. Cuticula pilei hymeniformis, echinidiis 10-20 X 7-12 µm, cylindricis vel clavatis, tenuitunicatis, cum 10-25 projecturis hyalinis vel luteolis 3-6 (-8) X 1-2 µm praedita. Cortex stipitis laevis. Holotypus: NORTH CAROLINA: Henderson Co.: Elks, Green Cove, *prope* Tuxedo, 14 Sep 1974, Gilliam 1557 (MICH).

PILEUS 19-45 mm broad; campanulate to hemispheric at first, becoming conic-convex to convex with the disc broadly depressed or not, occasionally papillate or umbonate; dry; dull; opaque; smooth at first, becoming minutely rugulose on the disc; deeply and distantly plicate except in very young pilei; entire or scalloped; pliant; reviving. CUTICLE minutely velutinous; strong brown (Hazel), near moderate brown (Russet), or moderate reddish brown (Mahogany Red) overall at first, remaining these colors on the disc in age, the margin becoming strong brown (Sanford's Brown) to brownish orange (Cinnamon Rufous). TRAMA thin (less than 1 mm thick); white. ODOR mildly farinaceous. TASTE farinaceous.

LAMELLAE broad (up to 6 mm broad); thin; distant; moderately numerous (23-28); equal; free; membranous but not fragile; entire; subventricose; slightly intervenose or not; not forked; yellowish white.

STIPE 54-80 mm long, 1-1.25 mm thick; equal or tapered slightly to the base; straight or curved; dry; shining; opaque; hollow; horsehair-like; even; glabrous; moderate pink at the apex, shading downward through strong brown or blackish brown to black at the base. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM a tuft of cottony white hairs.

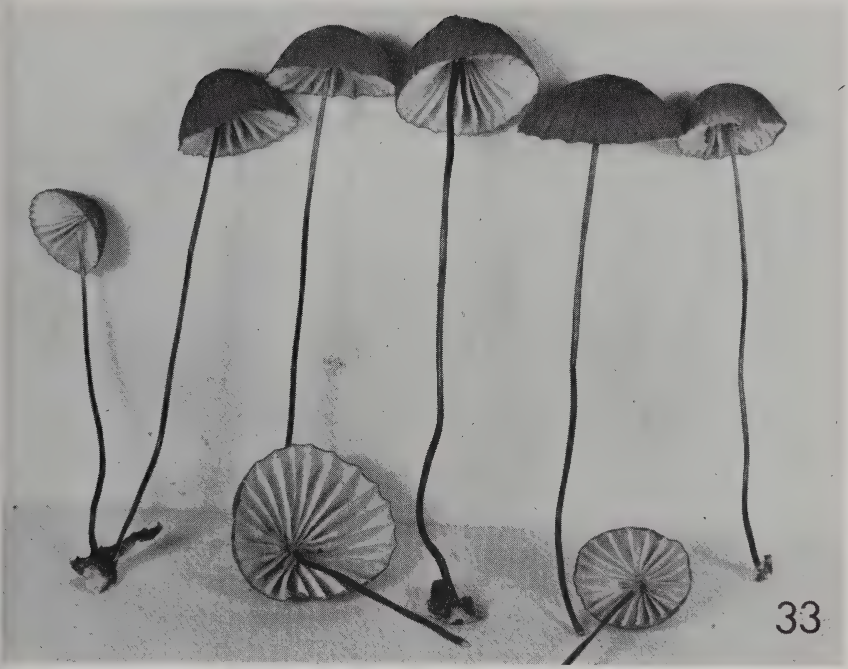


Figure 33. *Marasmius fulvoferrugineus.* Harrison 11065, x 3/4 (courtesy of Kenneth A. Harrison).

SPORES white in mass; 15.2-18 X 3-4.5 µm; oblanceolate, curved-clavate, or fusoid-clavate. BASIDIA 35-38 X 8-12 µm; clavate or subclavate; 4-spored. BASIDIOLES subclavate to subfusiform.

HYMENIAL CYSTIDIA rare or lacking; if present, 38-42 X 6-8 µm; clavate or fusoid-clavate; capitate or attenuate; hyaline and lacking refractive contents; arising at the same level as the basidioles; nonamyloid.

HYMENIAL BROOM CELLS 8-18 X 8-12 µm; cylindric, clavate or obovate; usually not pedicellate; with 8-25 hyaline or rarely pale orange yellow projections 2-8 X 1-3 µm which are rounded, smooth to slightly roughened, often branched or lobed, and divergent; with walls up to 1 µm thick; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated up to 12 µm in

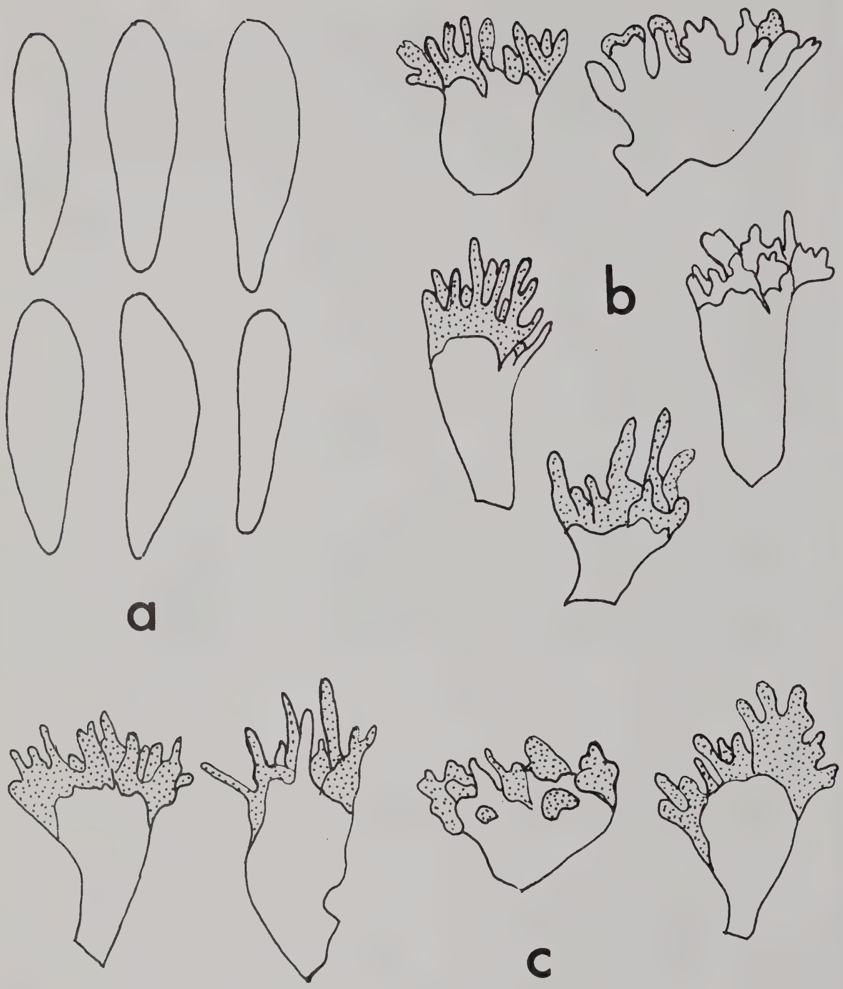


Figure 34. *Marasmius fulvoferrugineus.* Gilliam 1557, x 2300. a. Spores. b. Broom cells from the lamellar edge. c. Broom cells from the pileus cuticle.

the pileus; parallel to interwoven, uninflated and up to 6 µm broad in the lamellae; clamped; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of short-clavate, obovate, or broadly turbinate broom cells 10-20 X 7-12 µm, usually not pedicellate, with 10-25 pale orange yellow to light yellowish brown, divergent to strongly divergent, smooth or knobby, blunt, often branched or lobed, dextrinoid, rodlike to wartlike projections 3-6(-8) X 1-2 µm, with hyaline to pale orange yellow walls up to 1 µm thick.

STIPE corticated overall, only thinly so apically. CORTICAL HYPHAE 3-6 µm broad; with light yellowish brown to deep brown walls up to 1 µm thick; dark grayish olive green in 2% KOH; dextrinoid. TRAMAL HYPHAE 3-8 µm broad; with thin, hyaline walls; clamped; dextrinoid to nonamyloid. STIPE VESTURE lacking.

Scattered to gregarious in mixed woods. Fruiting period: mid-July to mid October.

Collections examined:

FLORIDA: West & Murrill, 8 Nov 1932 (NY). NEW JERSEY: Ellis, 1 Sep 1896 (NY). NORTH CAROLINA: Gilliam 1557 (holotype of *Marasmius fulvoferrugineus* Gilliam) & 1558; Harrison 11061 & 11065. TENNESSEE: Hesler 5451 (FH). VIRGINIA: Singer, 11 Sep 1934 (FH).

Marasmius fulvoferrugineus is the common southeastern species which has usually been determined as *M. siccus*. Comparison between the present taxon and the type of *M. siccus* reveals a number of differences which justify describing *M. fulvoferrugineus* as new. The large, refractive hymenial cystidia present in *M. siccus* are lacking. The pileus is generally larger (19-45 mm vs. 2.5-27 mm broad) and its colors more nearly rusty brown or cinnamon rather than the orange shades of *M. siccus*. Spores of *M. fulvoferrugineus* are usually somewhat shorter than those of *M. siccus* (up to 18 µm long vs. up to 21-23 µm). The walls of the cuticular broom cells are thinner. Finally, *M. siccus* occurs more frequently north of the Great Smoky Mountains, and *M. fulvoferrugineus* is found more often in the Great Smokies and to the south. Excellent color photographs of *M. fulvoferrugineus* (as *M. siccus*) have been published in Hesler (9) and Miller (21).

19. MARASMIUS SICCUS (Schweinitz) Fries, Epicr. Myc. 382. 1838. FIGS. 7, 35, & 36

Agaricus siccus Schweinitz, Schriften Naturf. Ges. Leipzig 1: 84. 1822.

Marasmius campanulatus Peck, Annual Rep. New York State Mus. 23: 126. 1870 (1873).

Marasmius fulviceps Clements, Bot. Surv. Nebraska 4: 20. 1896. Non *M. fulviceps* Berkeley, London J. Bot. 6: 490. 1847.
Marasmius clementsianus Saccardo & Sydow, Syll. Fung. 14: 101. 1899, *nom. nov.* for *Marasmius fulviceps* Clements.

PILEUS 2.5-27 mm broad; convex, conic-convex, pulvinate, or campanulate at first, soon broadly convex to broadly campanulate and often papillate, umbonate, or with a flat central depression; dry; dull; opaque; smooth at first, soon rugulose and usually conspicuously roughened; deeply plicate or sulcate to the disc except in very young pilei, the sulcae up to 3 mm apart in expanded pilei; entire, scalloped, crenate, or lobed; fragile to pliant; reviving. CUTICLE minutely velutinous; deep orange (M&P 13A12, Xanthine Orange, Orange Rufous), strong yellowish brown (Ochraceous-Tawny), or strong brown (Sanford's Brown) at first, remaining these colors or fading to brownish orange (M&P 11K7, Cinnamon Rufous), moderate orange (Apricot Buff), deep orange yellow (M&P 12G8-9, Mars Yellow), or light orange yellow (M&P 9E-F3), often darker on the disc. TRAMA thin (less than 1 mm thick); white. ODOR mild or absent. TASTE mild, rarely somewhat bitter, or occasionally absent.

LAMELLAE narrow at first, becoming moderately broad (1.5-3 mm broad); thin; distant to remote; moderately numerous (15-22 reach the stipe); equal or with 1-3 short lamellulae; adnexed, sinuate, or free; fragile or pliant; entire; straight at first, often ventricose in age; not intervenose; usually not forked; white or pale yellowish white, rarely with the edge brownish orange.

STIPE 23-62 mm long, 0.2-1.0 mm thick; central; terete; equal, tapered slightly to the apex, or occasionally swollen at the apex or base; straight or curved; dry; dull at first, polished in age and on drying; opaque; hollow; cartilaginous to horny; even; glabrous; white, yellowish white, pale yellow (M&P 11G3), or rarely dark red at the apex, darkening from the base upward through light yellowish brown to deep brown, with the darker colors almost overall in age, sometimes with a ring of brownish orange at the juncture of pileus and stipe. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM a disc-shaped patch of white to yellowish white hairs.

SPORES white in mass; (13.3-)16-21(-23) X 2.8-4.2(-5) µm; narrowly clavate, oblong-oblanceolate, or asymmetrically fusoid-clavate and often curved. BASIDIA 21-50 X 4-8 (-10) µm; clavate, subclavate, or subcylindric; 4-spored. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 23-67(-81) X 3-14 µm; cylindric, clavate, fusiform, fusoid-clavate, or fusoid-ventricose, often with an abruptly bent pedicellate base; usually rounded or subcapitate apically, but sometimes mucronate, submoniliform, or short- to long-appendiculate; with thin, hyaline walls and moderately to strongly refractive, hyaline to pale orange yellow homogeneous contents; arising in the subhymenium or deep in the trama; projecting up to 10(-20) µm beyond the basidioles; nonamyloid; rare to common on the lamellar faces.

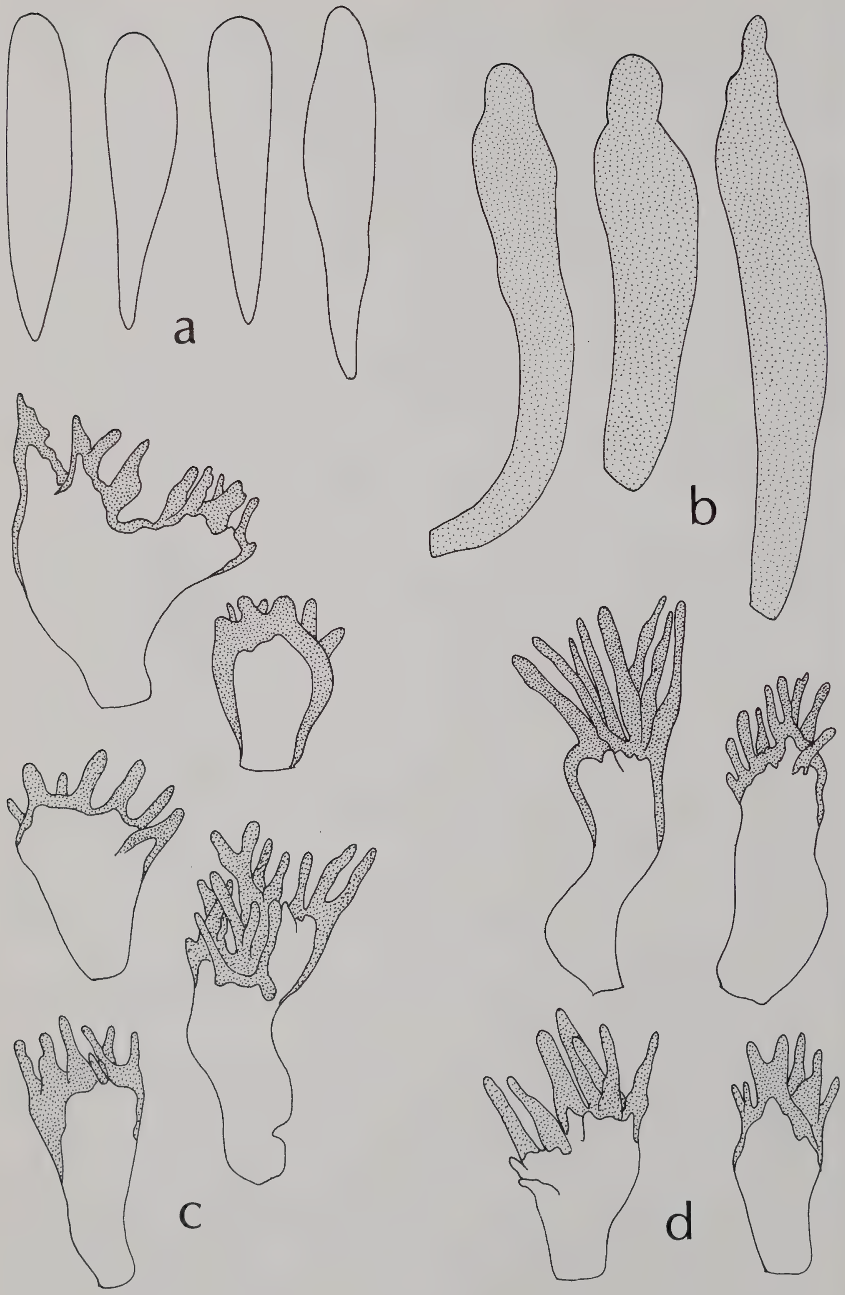
HYMENIAL BROOM CELLS 3-25 X 2-8.5 µm; cylindric, clavate, goblet-shaped, obovate, or lobed; with 3-15(-20) hyaline to pale orange yellow projections 4-10 X 1-1.5 µm which are rounded to acute, often roughened, dextrinoid, and parallel to divergent; with thin, hyaline walls; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated up to 18 µm broad in the pileus; parallel to interwoven, uninflated, and 2.5-5.0 µm broad in the lamellae; with thin, hyaline walls; dextrinoid, often with strongly dextrinoid granular contents in some cells.

PILEUS CUTICLE a hymeniform layer of subclavate, subglobose, pulvinate, turbinate, cylindric, lobed, or obovate broom cells 2.5-17(-21) X 2.5-8.5 µm, which are pedicellate or not, with (2-)6-15 pale orange yellow to light yellowish brown, parallel to divergent, usually smooth, blunt, rarely branched, dextrinoid, rodlike apical projections 1.4-7.0 X 1-1.5(-2) µm, with hyaline to pale orange yellow walls up to 2 µm thick.

STIPE corticated only in pigmented portions, the surface hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 3-5 µm broad; with light yellowish brown to strong brown walls up to 2 µm thick; dark grayish olive green in 2% KOH; dextrinoid or rarely nonamyloid at the apex of the stipe. TRAMAL HYPHAE 4-8 µm broad; with thin, hyaline walls; dextrinoid. VESTURE lacking or of rare, scattered broom cells at the juncture of stipe and pileus.

Scattered to gregarious and sometimes in troops on leaf mold, oak leaves, and twigs, on needles of white pine, or rarely on wood in beech-maple, oak-hickory, or pine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forests. Fruiting period: 3 July-6 October.

Collections examined:

CANADA: ONTARIO: Cain 24905 (BPI). JAPAN: Yasuda 279 (Lloyd 24829, BPI). UNITED STATES: CONNECTICUT: Underwood & Earle (NY). DISTRICT OF COLUMBIA: Murrill, 14-15 Jul 1905 (NY); Scribner, 1886 (BPI). ILLINOIS: Shaffer 845. INDIANA: Cooke 32728 & 32873; Shaffer 1240; Wright, 26 Sept 1938. MARYLAND: Kelly 504. MASSACHUSETTS: Bigelow 7113 & 15226; Underwood, Jul 1887 (NY). MICHIGAN: Ammirati 2450; Gilliam 638, 712, 756, 869, 940, 1237, & 1315; Patrick 428; Peters 1177; Potter 5695; Shaffer 2510, 2650; Smith 6539, 6884, 18461, 51193, & 74424. MINNESOTA: Weaver 1232. MISSOURI: Linder, 24 Aug 1928 (BPI, FH). NEBRASKA: Clements, 7 Sep 1895 (isotype of *Marasmius fulviceps* Clements, BPI). NEW YORK: Gilliam 1232; Peck, Aug (lectotype of *Marasmius campanulatus* Peck, NYS); Murrill, 7-17 Aug 1916 (NY); Underwood, Sep 1888 (NY). NORTH CAROLINA: Harrison 10971. OHIO: Moldenke 13744 (FH). PENNSYLVANIA: Schweinitz (holotype of *Agaricus siccus* Schweinitz, PH; part also collected in South Carolina). TENNESSEE: Hesler 10851 (FH); Murrill 18-24 Aug 1904 (NY). VERMONT: Pringle 1440 (FH). VIRGINIA: Kauffman, 24 Jul 1919; Linder, 2-4 Sep 1936 (FH); Murrill, 8-14 Jul 1909 & Jul 1910 (NY). WISCONSIN: Gilliam 1226; Shaffer 334; Sherman (NY).

An examination of many specimens tentatively determined as *Marasmius siccus* shows that the prevalent concept of this species is too broad. I have examined the type of *Agaricus siccus* Schweinitz and find it to belong to the common taxon with a moderate orange, distinctly sulcate pileus, spores up to 20 µm long, and conspicuous refractive hymenial cystidia. The types of *M. campanulatus* Peck and *M. fulviceps* Clements, which I have also seen, belong to this taxon as well. At least four other species have been commonly misidentified as *M. siccus: M. pulcherripes* Peck (both a pink and a yellowish brown variant), *M. borealis* Gilliam, *M. bellipes* Morgan, and *M. fulvoferrugineus* (described as a new species in the present work). Reports of pink varieties of *M. siccus* in the literature probably stem from confusion with one of the above species, particularly

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Figure 35. *Marasmius siccus*. Gilliam 869. a. Spores, x2300. b. Hymenial cystidia, x1500. c. Broom cells from pileus cuticle, x2300. d. Broom cells from lamellar edge, x2300.

Marasmius pulcherripes and perhaps forms of *M. fulvoferrugineus*. *M. siccus* is never pink but rather some shade of orange or brown at all stages of development. For the differences between *M. siccus* and closely related species, see the discussions under *M. borealis* (8), *M. pulcherripes*, *M. bellipes*, and *M. fulvoferrugineus*.

20. MARASMIUS SPADICEUS Gilliam, Mycologia 67: 840. *f. 33-36.* 1975.

PILEUS 15-30 mm broad; convex or nearly plane; hygrophanous; opaque; closely translucent-striatulate on the margin in age; somewhat fleshy. CUTICLE minutely velutinous; moderate brown (Argus Brown) to strong brown (Amber Brown) at first, fading to brownish orange (near Cinnamon-Rufous), strong brown to deep brown in dried material. TRAMA thick in the disc, thin on the margin; white. ODOR faint. TASTE mild or lacking.

LAMELLAE narrow; thin; close to crowded; numerous; unequal, with numerous lamellulae; free, but with a few lamellae touching the stipe; entire; ventricose; not intervenose; not forked; pale yellow at first, soon white or nearly so.

STIPE 30-50 mm long, 2-3 mm thick; central; terete; equal; straight; dry; polished; opaque; hollow; horny; even; glabrous; pale orange yellow above, deep brown below. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM tuftlike; white.

SPORES 6.7-10.8 X 2.8-3.5 µm; elliptic or pip-shaped. BASIDIA 21-29 X 4.5-7 µm; subclavate to clavate; 4-spored. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 22-33(-44) X 4-8.5 µm; clavate, fusoid-clavate, or fusoid-ventricose; capitate, short-appendiculate, submoniliform, or rounded apically; with thin, hyaline walls; usually embedded, rarely projecting beyond the basidioles; present but sometimes inconspicuous on the lamellar faces.

HYMENIAL BROOM CELLS 8.4-21 X 3-6 µm; cylindric or short-clavate; with few (3-8) pale yellow to light yellowish brown, rodlike projections 7-13 X 1-2.2 µm which are usually tapered, often branched, usually acute, divergent, and dextrinoid; with thin, hyaline to light yellowish brown walls; present only on the lamellar edges.

TRAMAL HYPHAE closely interwoven and inflated up to

17 µm broad in the pileus; parallel to interwoven, uninflated, and 4-10 µm broad in the lamellae; dextrinoid.

PILEUS CUTICLE a hymeniform layer of cylindric to short-clavate and often pedicellate broom cells 7-28 X 4-8.5 µm, with few (2-10) light yellowish brown to moderate brown, rodlike projections 7-14 X 1-2.2 µm which are tapered or not, sometimes branched, smooth, divergent, and dextrinoid; with hyaline to moderate brown walls up to 1 µm thick.

STIPE corticated overall at maturity. CORTICAL HYPHAE 4-11 µm broad; with light yellowish brown walls up to 1.5 µm thick, or with the wall occluding the lumen; dextrinoid; grayish greenish yellow in 2% KOH. TRAMAL HYPHAE up to 8.5 µm broad; with thin, hyaline walls or with pale yellow walls occluding the lumen; dextrinoid. STIPE VESTURE lacking except for rare, scattered short broom cells at the juncture of the pileus and stipe.

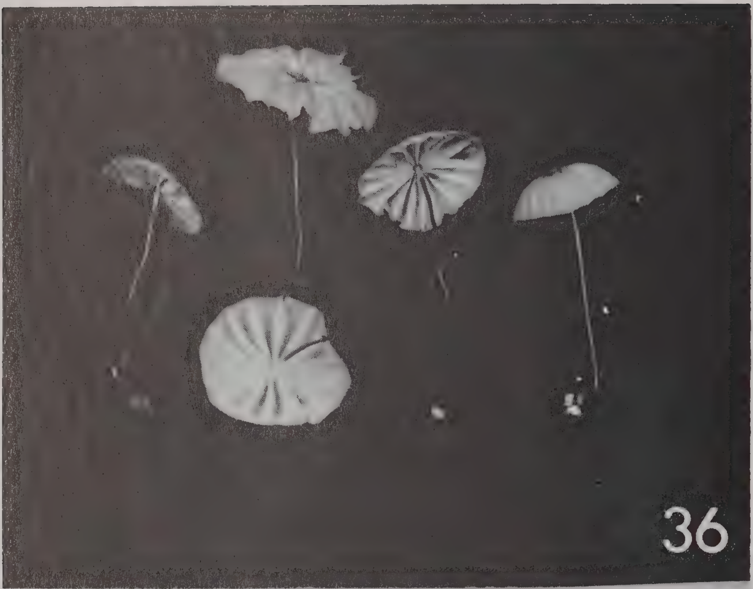
Scattered on decayed leaves in oak woods. Fruiting period uncertain; only known specimen found in mid-July.

Collection examined:

MICHIGAN: Smith 6591 (holotype of *Marasmius spadiceus* Gilliam).

21. MARASMIUS GLABELLUS Peck, Bull. Buffalo Soc. Nat. Sci. 1: 58. 1873 (1874). FIGS. 37 & 38

PILEUS 5-24 mm broad; convex or broadly campanulate at first, then convex or plano-convex and sometimes with a low umbo or indistinct central papilla, finally depressed, with the margin remaining decurved throughout; dry; dull; opaque; smooth at first, soon minutely rugulose on the disc; faintly to conspicuously striate up to 7/8 the pileus radius, particularly in age, the striae unequal in length and sometimes forming a star-shaped pattern on the disc at first; entire to crenate; pliant, but cracking on the surface when bent. CUTICLE minutely velutinous; at first deep yellowish brown (Sudan Brown), moderate brown (Verona Brown), moderate yellowish brown (Snuff Brown, M&P 13G8), or rarely strong brown, often with pale orange yellow radial striae, in age fading to pale orange yellow (Pinkish Buff) overall or retaining areas of deep yellowish brown on the disc, in dried basidiocarps deep yellowish brown, dark yellowish brown, or deep brown, often with light yellowish brown radial striae. TRAMA up to 1 mm thick in the disc; pliant; yellowish white. ODOR of crushed pilei mild



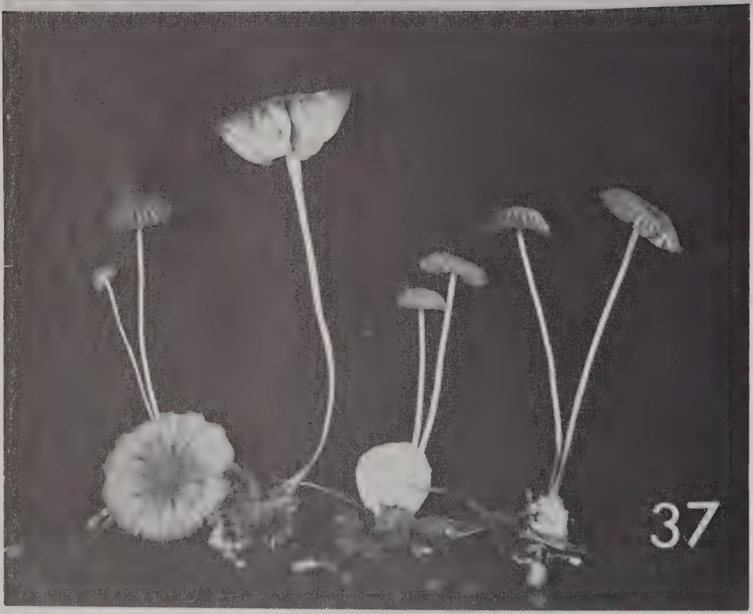


Figure 36. *Marasmius siccus*. Gilliam 869, x 1.

Figure 37. *Marasmius glabellus*. Gilliam 801, x 1.

with a spermatic component. TASTE mild, with a spermatic aftertaste.

LAMELLAE broad (1-6 mm broad); moderately thick; distant; few (12-15 reach the stipe); unequal, with the lamellulae alternating with the lamellae in a regular pattern; emarginate to free; pliant; entire; faintly intervenose at first, strongly so in age; not forked; pale yellow to yellowish white, sometimes with brown edges.

STIPE 15-58 mm long, 0.75-1.8 mm thick; central; terete, or flattened at the apex; equal or tapered slightly to the base; straight or curved, usually curling upon drying; dry; shining; opaque; hollow; broomstraw-like, or sometimes horny in old basidiocarps; even; glabrous; white at the apex at first, then yellowish white (M&P 9B2), the basal portion becoming light yellowish brown or moderate reddish brown (Chestnut) to deep brown, with the darker colors almost overall in age. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM tuftlike or cushion-like; of matted-fibrillose or cottony-tomentose, white to pale orange yellow hairs.

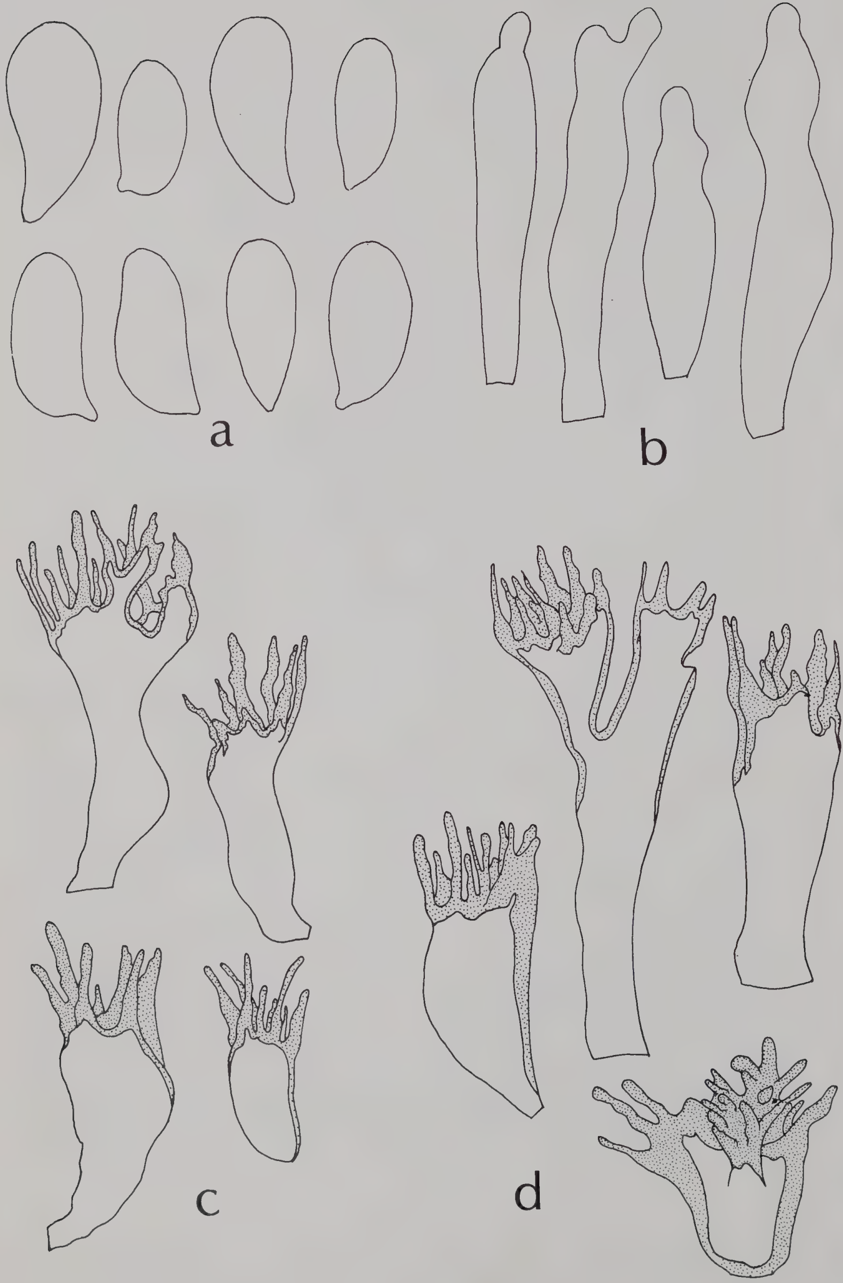
SPORES white in mass; (6-)7.0-11.5 X 3.1-6.0 µm; fusoid-elliptic, obovate, or broadly pip-shaped. BASIDIA 21-39 X 4-7 µm; subclavate to clavate; 4-spored. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 20-46 X 4-8 µm; fusoid-clavate; fusoid-ventricose, clavate, subcylindric, or rarely lobed; subcapitate, submoniliform, or capitellate, or if not, rounded apically; with thin, hyaline walls; nonamyloid; embedded or projecting up to 12 µm beyond the basidioles; rare and inconspicuous on the lamellar faces.

HYMENIAL BROOM CELLS 4.2-28 X 4-10 µm; elliptic, cylindric, clavate, hemispheric, or pedicellate and abruptly expanded at the apex; with 4-20 divergent, usually roughened, tapered, rodlike, dextrinoid projections 5.6-8.4 X 0.5(-1) µm; with hyaline to pale yellow walls up to 0.5 µm thick at the apex.

TRAMAL HYPHAE parallel to interwoven in the lamellae, interwoven in the pileus; inflated (up to 11 µm broad); with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of two types of broom cells: (1) cylindric, clavate, lobed, or rarely hemispheric broom cells 7-17(-28) X (3-)5-8.5 µm which are pedicellate or not, with 8-20 usually divergent, roughened,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sometimes short-branched projections 4-10 X 0.5-1.5 µm; and (2) isolated inset broom cells which are larger (up to 24 X 7 µm), with as few as 2 apical projections and with moderate orange yellow walls up to 2 µm thick.

STIPE corticated only in pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 3-5 µm broad; with pale yellow to moderate orange yellow walls up to 2 µm thick; dextrinoid. TRAMAL HYPHAE 4-7 µm broad; with thin, hyaline walls; dextrinoid. STIPE VESTURE lacking except for rare broom cells at the juncture of pileus and stipe.

Gregarious or subcespitose on decayed leaves in deciduous woods. Fruiting period: 5 Jul-29 Sep.

Collections examined:

INDIANA: Cummins, 27 Aug 1935 (FH). MICHIGAN: Gilliam 801 & 1551; Potter 4025; Smith 25892, 32857, 42151, 50039, 50040, 50041 & 74774. MISSOURI: Glatfelter 1136 (BPI). NEW JERSEY: Anderson, 20 Jul 1889 (NY). NEW YORK: Peck, Sep (NYS), Aug (NYS), & Jul & Aug (holotype of *Marasmius glabellus* Peck, NYS). NORTH CAROLINA: Harrison 11212. OHIO: Cooke 35821.

The distinctive combination of features which characterizes *Marasmius glabellus* includes the yellowish brown pileus color; the distant, rather shallow striae or sulcae on the pileus; and the distant, broad lamellae. The stipe is glabrous except for a conspicuous mycelial pad. Spores of *M. glabellus* are intermediate in length for species of section *Sicci*, are unusually broad, and have an apiculus which is more clearly defined than usual. Since pilei of basidiocarps of *M. glabellus* are smooth and convex at first, some specimens of *M. glabellus* may be confused with forms of *M. sullivantii*. For a comparison with that species, see the discussion under *M. sullivantii*.

Examination of the type specimen without reference to other collections gives a false impression of the size of the pileus in *M. glabellus*. All other collections that I have seen have had smaller pilei.

Figure 38. *Marasmius glabellus*. a. Spores, Gilliam 801, x2300. b-d. Gilliam 1500. b. Hymenial cystidia, x1500. c. Broom cells from lamellar edge, x2300. d. Broom cells from pileus cuticle, x2300.

22. MARASMIUS BELLIPES Morgan, J. Mycol. 11: 207. 1905.
FIGS. 6 & 39

Marasmius glabellus Peck var. *bellipes* (Morgan)
Kauffman, Agar. Michigan 1: 66. 1918.

PILEUS 4-15 mm broad; campanulate at first, soon broadly pulvinate to convex and then convex-depressed, retaining throughout a conspicuous papilla, finally broadly convex-depressed; dry; dull; opaque; even at first, soon obscurely and then prominently striate to the central papilla. CUTICLE minutely velutinous; deep purplish red overall in the button stage, remaining so or becoming deep reddish brown on the papilla and fading on the disc through strong brown to light brown and finally light yellowish brown, paler over the striae.

LAMELLAE moderately broad; thin; distant; moderately numerous (20-25 reach the stipe); equal; crisped upon drying; pale yellow (dried).

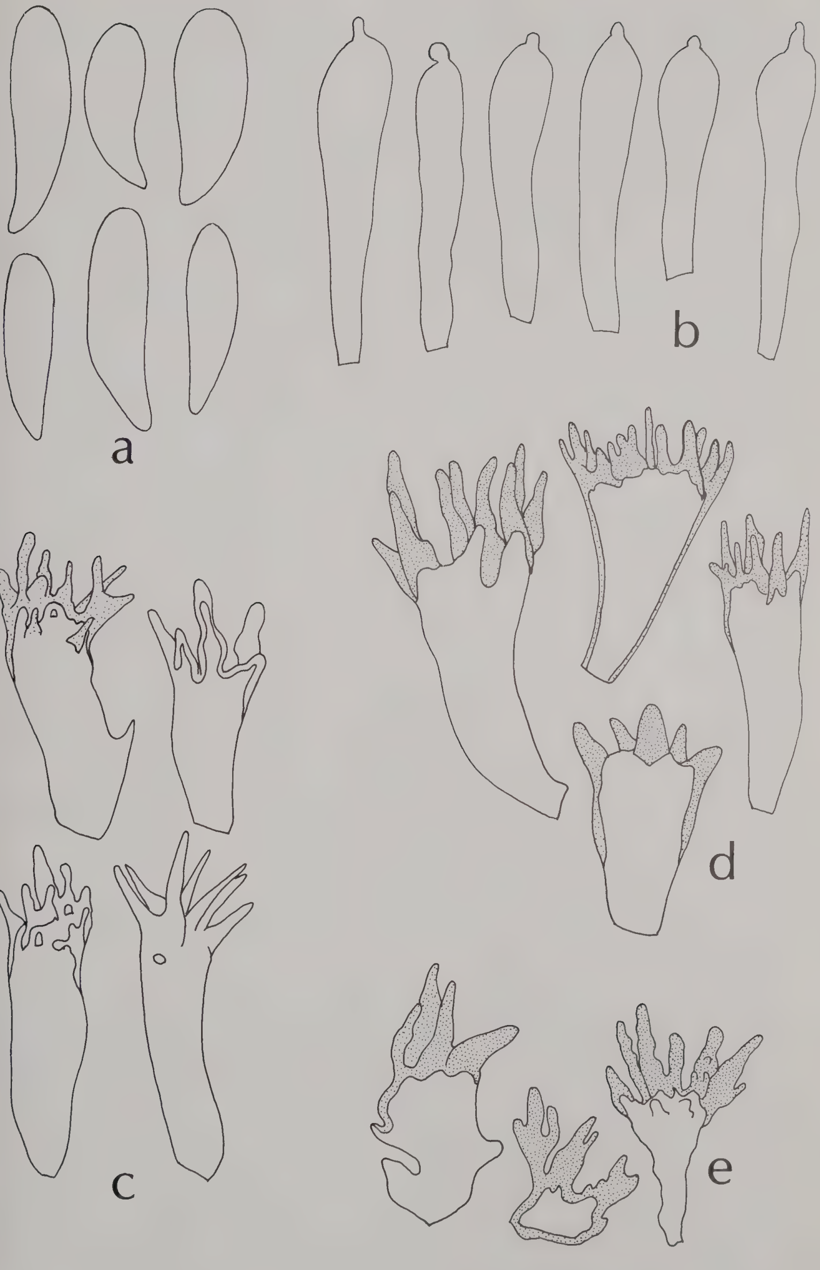
STIPE 22-40 mm long, 0.3-0.75 mm thick; equal or slightly tapered to the base or apex; straight; dry; shining; opaque; glabrous; hollow; broomstraw-like; smooth; very deep purplish red in the button stage, then grayish purplish red or moderate purplish red, fading from the base upward to light yellowish brown, becoming dark grayish brown at the base in age. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM often uniting several stipes; cottony; white; extensive.

SPORES 8.4-12(-14.6) X 2.8-3.6(-4.4) µm; curved-clavate, fusoid-elliptic, or pip-shaped. BASIDIA 26-32 X 4-5.5 µm; clavate. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 26-38 X 4-6 µm; clavate to cylindric; capitellate or short-appendiculate; with hyaline, thin walls; nonamyloid; scarcely projecting; infrequent to moderately abundant on the lamellar faces.

HYMENIAL BROOM CELLS 8-16 X 4-5.5 µm; narrowly clavate to cylindric; with hyaline to pale yellow, smooth or somewhat roughened, usually acute, dextrinoid projections 1-3.5 X 0.2-1.2 µm; with thin, hyaline walls; abundant on the lamellar edges.

Figure 39. *Marasmius bellipes*. Morgan, 1905 (type).
a. Spores, x 2300. b. Hymenial cystidia, x1500.
c. Broom cells from lamellar edge, x2300. d. Broom cells from pileus cuticle, x2300.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TRAMAL HYPHAE of pileus and lamellae 4-7 µm broad; interwoven; uninflated; with thin, hyaline walls; dextrinoid.

PILEUS CUTICLE a hymeniform layer of broom cells of two types: (1) short-clavate or obovate broom cells 5.5-18 X 4-11 µm which are often almost triangular in section and which have 6-20 roughened or smooth, hyaline to dark orange yellow, often tapered, dextrinoid projections 2-7 X 0.3-2.0 µm and pale orange yellow walls up to 2 µm thick; and (2) isolated inset broom cells with walls up to 2 µm thick, often bent or contorted, with fewer, often broader, projections.

STIPE corticated only in the pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 2-4.5 µm broad; with dark orange yellow walls up to 1 µm thick, or with the wall occluding the lumen. TRAMAL HYPHAE up to 6 µm broad; with thin, hyaline walls, or with the wall pale yellow, refractive, and occluding the lumen. VESTURE present only at the extreme apex of the stipe; of rare broom cells with a reduced or obsolescent base and numerous dark orange yellow, rodlike projections 2-8 X 0.5-1.5 µm.

Gregarious on old leaves in deciduous woods. Fruiting period: 8 June-11 September.

Collections examined:

OHIO: Morgan, 1906 (5 collections, IA), 8 Jun 1892 (IA), & 11 Sep 1905 (holotype of *Marasmius bellipes* Morgan, IA). WISCONSIN: Mazzer 6626.

The macroscopic description is based on notes from fresh material by Samuel Mazzer and on my own observations of the type specimens.

Morgan's specimens of *Marasmius bellipes* look similar to *M. glabellus*, since both species have convex, distantly striate pilei and broad lamellae. The purple tints of the stipe and the disc of *M. bellipes*, together with narrower spores, distinguish it from *M. glabellus*. From *M. pulcherripes*, which also usually has pink or purple colors on the pileus, *M. bellipes* differs in having broad, distant lamellae and a distantly striate, convex-depressed pileus, as well as shorter, relatively narrower spores. *M. bellipes* is closest to *M. borealis*, but this latter species has a smooth (non-sulcate) light yellowish brown pileus at maturity, narrow lamellae, and larger spores.

23. MARASMIUS PULCHERRIPES Peck, Annual Rep. New York State Mus. 24: 77. *pl. 4, f. 19-22.* 1871 (1872).

FIG. 40

PILEUS 3-15(-20) mm broad; obtusely to sharply conic or campanulate at first, becoming conic-convex, campanulate with a sharp central papilla or umbo, finally broadly convex-umbonate, plano-umbonate, or plano-convex, with the margin flared or not; dry; dull; opaque, or sometimes translucent on the margin; minutely granular-roughened; even at first, soon closely to distantly plicate or striate; entire or crenate; membranous and delicate; reviving. CUTICLE minutely velutinous; at first moderate yellowish pink, dark yellowish pink (M&P 4J9), grayish reddish orange (M&P 5D-E10, Etruscan Red), grayish red (M&P 6J-K8, Indian Red, Corinthian Red), or moderate reddish brown (M&P 7H10), in some strains brownish orange or light yellowish brown from the first, the disc often darker [moderate reddish brown, dark reddish brown, or grayish red (Ocher Red) in pink strains, brownish orange in light yellowish brown strains], on drying and in age remaining these colors or fading to moderate yellowish pink (Vinaceous Fawn), grayish yellowish pink (Light Vinaceous-Fawn), or light yellowish brown (M&P 11B6, 11D4-6, 11I5, 12C7, 12H7-8), sometimes with the disc moderate brown (M&P 15A9) to light grayish reddish brown (Fawn Color). TRAMA thin (less than 1 mm thick in the disc); fragile; white. ODOR lacking. TASTE lacking or rarely faintly raphanoid or bitter.

LAMELLAE narrow, becoming moderately broad in age (1.5 mm broad in a pileus 9 mm broad); thin; subdistant to distant; moderately numerous (15-23 reach the stipe); equal, or if unequal, with only 1 or 2 short lamellulae; adnexed to free or rarely with a partial, adnate collar; fragile; entire or occasionally serrate or dentate; straight at first, becoming ventricose in age; not intervenose; not forked; crisped or not; often pale yellowish pink (Tilleul-Buff) or pinkish gray (Pale Ecru-Drab) at first, soon white or nearly so (M&P 9B1, 11B2), sometimes with minute brown dots on the lamellar edge.

STIPE 16-63 mm long, 0.2-0.6 mm thick; central; terete; equal, or enlarged slightly at the apex; straight or curved and often twisted; dry; shining; opaque; hollow; wiry; even; glabrous; moderate pink, dark pink, grayish red, grayish yellowish pink (Light Vinaceous-Fawn) or light yellowish brown overall at first and later on the apex only, the basal portion becoming grayish yellow (M&P 11C4), dark orange yellow (M&P 13K9), light yellowish brown, or moderate reddish brown to dark reddish brown or blackish brown, with the darker colors extending progressively upward in age. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM tuftlike; white or sometimes grayish white; rarely extending to the surrounding substrate.

SPORES white in mass; (9.5-)11.0-15.2(-16.8) X 2.8-4.3 µm; narrowly curved-clavate, subfusiform, narrowly tapered-elliptic, or occasionally pip-shaped. BASIDIA 19.5-36.5 X 4.5-7 µm; clavate, subclavate, or subcylindric; 4-spored. BASIDIOLES subclavate.

HYMENIAL CYSTIDIA 20-60 X 2-11 µm; cylindric, clavate, fusiform, fusoid-clavate, or fusoid-ventricose; capitellate, submoniliform, or short- to long-appendiculate, or if not, then rounded apically; with thin, hyaline walls; nonamyloid; embedded or projecting up to 15 µm beyond the basidioles; rare to common on the lamellar faces.

HYMENIAL BROOM CELLS 2-17(-25) X 2-8.5 µm; cylindric, clavate, pyriform, subglobose, lobed, or strongly reduced; with numerous (5-20) pale yellow to moderate orange yellow, parallel to slightly divergent, equal, smooth, dextrinoid, rodlike projections 2-7 X 0.5(-1) µm, or rarely with a few hyaline diverticula up to 2 µm long; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated (up to 11 µm broad) in the pileus; parallel to interwoven, uninflated and 3-6 µm broad in the lamellae; hyaline; dextrinoid.

PILEUS CUTICLE a hymeniform layer of two types of broom cells: (1) cylindric, clavate, ovate, elliptic, globose, deeply 2-lobed, or hemispheric and occasionally pedicellate broom cells 3-18 X 3-11(-14) µm, with 6-30 equal, parallel to slightly divergent, usually smooth, rounded, rodlike projections 2.8-9.8 X 0.5 µm which are dark red to moderate pink in water when fresh (pink strains) but moderate orange yellow to light yellowish brown otherwise (in light yellowish brown strains and in pink strains when revived in 2% KOH), with hyaline to pale pink walls up to 1 µm thick; and (2) broom cells at regular intervals with pale yellow to moderate orange yellow walls up to 2 µm thick and with fewer projections which are up to 2 µm thick.

STIPE corticated only in pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated.

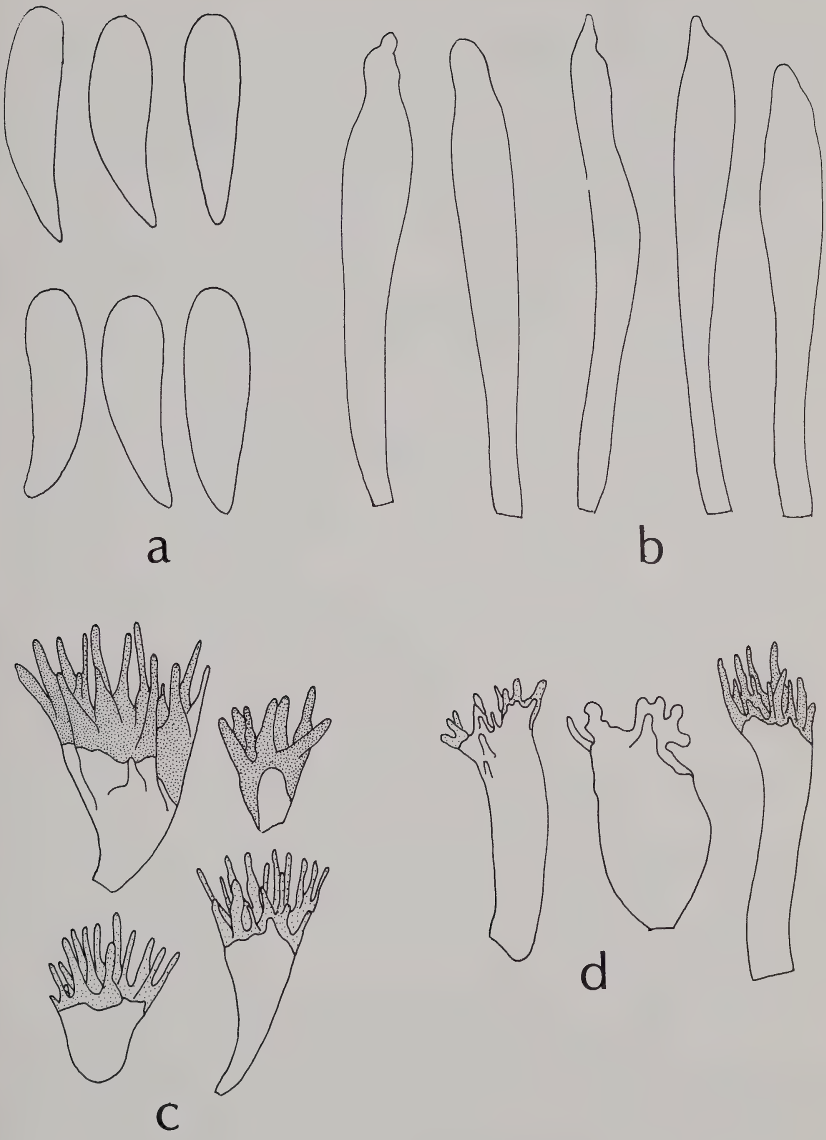


Figure 40. *Marasmius pulcherripes*. Gilliam 670. a. Spores, x2300. b. Hymenial cystidia, x1500. c. Broom cells from lamellar edge, x2300. d. Broom cells from pileus cuticle, x2300.

CORTICAL HYPHAE 6-8 µm broad; with walls up to 2.5 µm thick which are strong brown in water when fresh and olive green when revived in 2% KOH. TRAMAL HYPHAE 3-14 µm broad; with thin, hyaline walls or rarely with pale yellow refractive walls which completely fill the lumen. STIPE VESTURE lacking except for rare, scattered moderate pink to moderate red or light yellowish brown (in water mounts) irregular broom cells at the juncture of stipe and pileus.

Gregarious on deciduous leaves, pine needles, and woody debris in deciduous, deciduous-coniferous, and coniferous woods. Fruiting period: 17 June-13 October.

Collections examined:

CONNECTICUT: Earle (NY). MARYLAND: Kelly 22. MASSACHUSETTS: Bigelow 8254 (MASS) & 8525 (MASS); Linder, 20 Jun 1942 (FH). MICHIGAN: Gilliam 631, 670, 739, 740, 811, 813, 814, 871, 872, 873, 927, & 928; Nimke 35; Shaffer 2524 & 2652; Smith 6520, 39364, 41689, & 63063. NEW YORK: Bigelow 5129 (MASS); Peck, 9 Aug (lectotype of *Marasmius pulcherripes* Peck, NYS). NORTH CAROLINA: Harrison 10969, 10978, & 10979. OHIO: Moldenke 13033 (FH). PENNSYLVANIA: Dallas, Jul 1902 (BPI). TENNESSEE: Hesler 9645 (FH). VERMONT: Bigelow 13469 (MASS).

Often considered simply a pink form of *Marasmius siccus*, *M. pulcherripes* is sufficiently distinct to be recognized at the specific level. The two species are compared below:

Character	*M. siccus*	*M. pulcherripes*
Pileus color when young	moderate orange to strong brown	pink to moderate red or light yellowish brown
Pileus shape	convex, often umbilicate	campanulate, then convex
Pileus texture	moderately tough	rather delicate
Color of extreme stipe apex	brownish orange, light yellowish brown	purplish pink, moderate red, rarely light yellowish brown
Spore length	up to 15-18(-20) µm	(9.5-)11-15.2 (-16.8) µm
Hymenial cystidia	pale yellow, refractive,	hyaline, not refractive, not curved

	curved basally, arising deep in the trama	basally, arising at the level of the basidioles
Cuticular broom cells	only of one type, with more or less uniformly thick walls	of two types, some with thin walls and narrow projections, others not

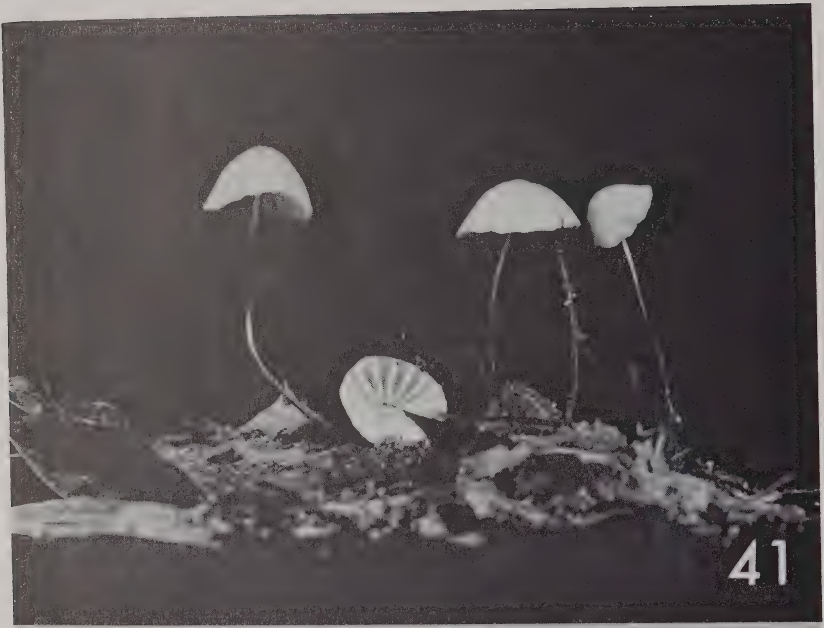
The holotype of *Marasmius pulcherripes* (NEW YORK: Garrisons, June, Peck, NYS) could not be located in the Peck herbarium; consequently I am following the suggestion of Stanley Smith that a lectotype be designated from among Peck's authentic collections. There are two such collections: Northville, (no date), Peck; and W. Shokan, 9 Aug, Peck. The Northville collection is mixed, containing several basidiocarps of *M. albiceps* (considered in the present work to be a *Mycena)*. It seems appropriate, then, to designate the W. Shokan collection as lectotype of *M. pulcherripes*.

According to Singer (39), *Marasmius pulcherripes* is the only acystidiate species of the North American *Sicci*. Although they are difficult to see except in squash mounts of 2% KOH and congo red, hyaline, usually capitate hymenial leptocystidia are present.

A common variant of *Marasmius pulcherripes* (e.g., Bigelow 8254, Gilliam 739 & 871) lacks the pink tints characteristic of the pileus and stipe but is otherwise similar in all respects. Microscopically the two are indistinguishable. Both the pink and the light yellowish brown forms may often be collected at the same site, although the groups of fruiting bodies do not occupy the same area.

24. MARASMIUS ROBINIANUS Gilliam, sp. nov. FIGS. 41 & 43

Pileus 4.5-13 mm latus, primitus hemisphaericus, obtuse conicus, vel rare campanulatus et interdum papillatus, in aetate convexus, membranaceus, distante plicatulus vel sulcatulus, ex aurantiaco aurantio-luteolus vel armeniacus, sulcis pallidioribus, inodorus. Sapor parum amarus. Lamellae angustae vel modice latae, tenues, distantes, paucae (11-16), aequales, adnexae vel subliberae, membranaceae, eburneae vel luteolae, in aetate albidae. Stipes 25-47 mm longus, 0.1-0.5 mm crassus, aequalis, nitidus, filiformis sed firmus et flexilis, apice eburneo vel flavissimo, base flavo-brunneo vel ferrugineo. Mycelium



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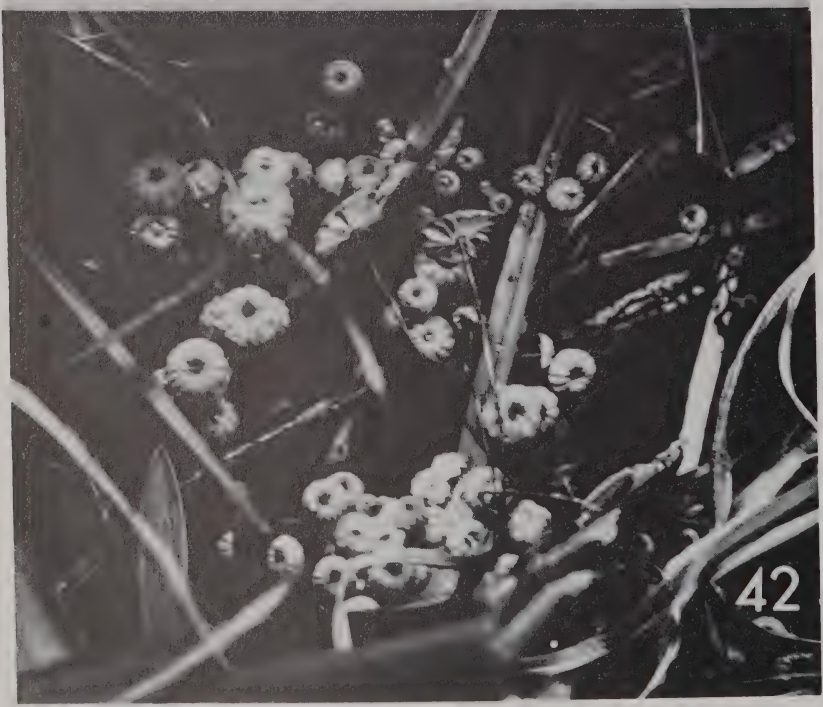

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basale pilis lutescentis in annulo tenuo. Sporae 9.8-15.7 X 2.8-4.2 µm, fusiformia vel clavata. Echinidia hymenii 5.5-20 X 4-7 µm, clavata vel cylindricia, tenuitunicata, cum 6-20 projecturis flavo-aurantiacis 4-9 X 0.5-1 µm praedita, in marginibus lamellibus. Trama pilei dextrinoidea. Cuticula pilei hymeniformis, echinidiis 7-17 X 3-10 µm, cylindrica, tenuitunicata et crassitunicata intervallis regularibus, cum 10-25 projecturis 3-5.5(-10) X 0.5-1.5 µm praedita. Echinidia in apice stipitis luteola. Holotypus: MICHIGAN: Livingston Co.: Oak Grove State Game Area, 18 Jul 1972, Gilliam 1511 (MICH).

PILEUS 4.5-13 mm broad; hemispheric, obtusely convex, conic-convex, or rarely campanulate, convex in age, papillate or not; dry; dull; opaque; smooth; at first even, then shallowly to deeply sulcate to the disc; entire, lobed or crenate; membranous and delicate. CUTICLE minutely velutinous; at first light orange to moderate orange overall, soon pale orange yellow to pale yellowish pink, often darker (moderate orange) on the papilla and paler on the sulcae. TRAMA thin; yellowish white. ODOR mild. TASTE faintly bitter, with a raphanoid aftertaste.

LAMELLAE narrow to moderately broad (1-2 mm broad); thin; distant; few (11-16 reach the stipe); equal, or with 1 or 2 lamellulae; adnexed or almost free; membranaceous; entire or minutely fimbriate; ventricose; not intervenose; not forked; yellowish white or pale yellow at first, becoming white in age.

STIPE 25-47 mm long, 0.1-0.5 mm thick; central; terete; equal; straight, or curved at the base; dry; shining; opaque; hollow; stiff and hairlike yet fragile; even; glabrous; yellowish white to brilliant yellow on the upper 1-4 mm, light yellowish brown, moderate yellowish brown, or deep yellowish brown to dark yellowish brown or strong brown below. STERILE STIPES and RHIZOMORPHS absent. BASAL MYCELIUM usually present as a faint pale yellow ring at the point of emergence.

SPORES 9.8-15.7 X 2.8-4.2 µm; clavate or naviculate. BASIDIA 24-32 X 5.5-7 µm; subclavate to clavate; 4-spored. BASIDIOLES subfusiform or subclavate.

HYMENIAL CYSTIDIA 31-42 X 4-10 µm; fusiform, clavate,

Figure 41. *Marasmius robinianus.* Gilliam 1511, x 1-1/4.

Figure 42. *Marasmius graminum,* x 1-1/2.

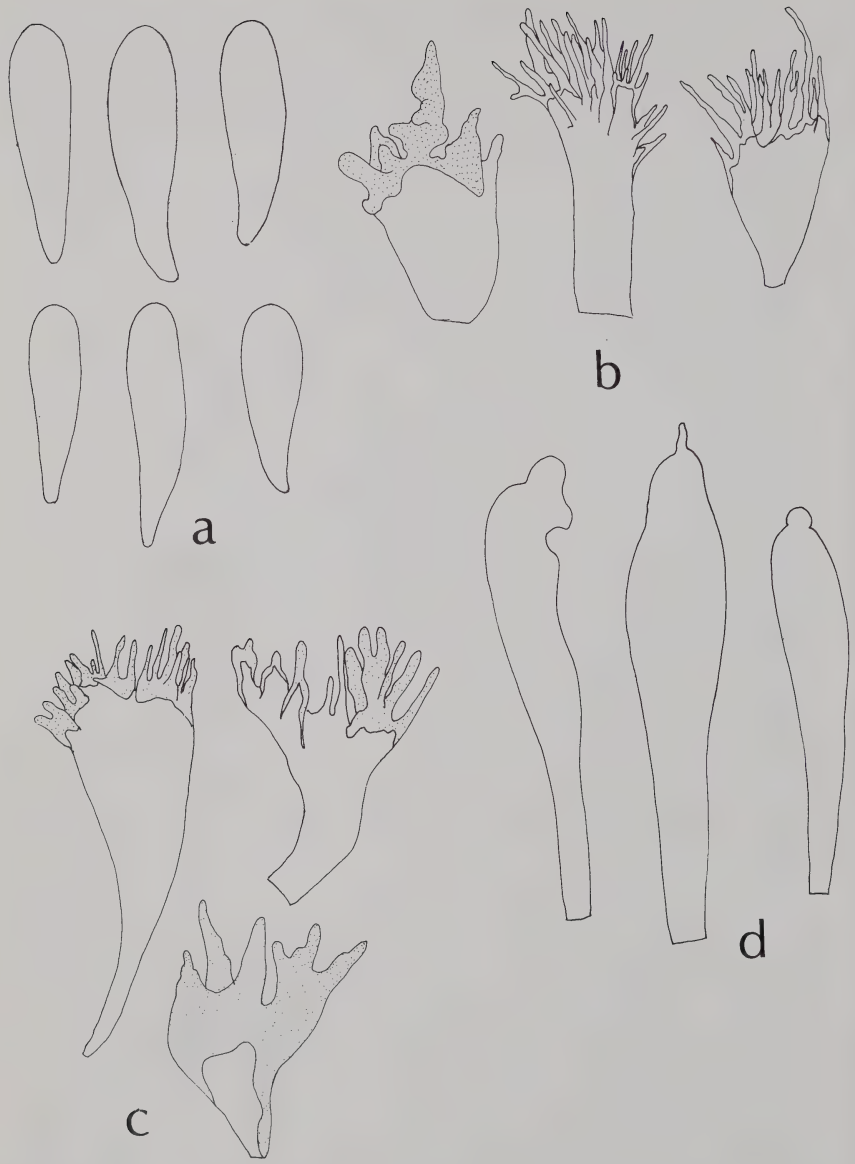

Figure 43. *Marasmius robinianus*. Gilliam 1511. a-c. x2300. a. Spores. b. Broom cells from the lamellar edge. c. Broom cells from the pileus cuticle. d. Hymenial cystidia, x1500.

or fusoid-clavate; rounded, subcapitate, or capitate apically; with hyaline walls up to 0.5 µm thick; projecting up to 14 µm beyond the basidioles; rare to moderately abundant on the lamellar faces.

HYMENIAL BROOM CELLS 5.5-20 X 4-7 µm; clavate or cylindric; with 6-20 smooth or roughened, acute, moderate orange yellow projections 4-9 X 0.5-1 µm thick; with hyaline or moderate orange yellow walls up to 0.5 µm thick.

TRAMAL HYPHAE of pileus and lamellae 3-11 µm broad; interwoven; uninflated; with hyaline walls up to 0.5(-1.0) µm thick; dextrinoid.

PILEUS CUTICLE a hymeniform layer of two types of broom cells: (1) cylindric to clavate or rarely lobed broom cells 7-17 X 3-10 µm, with 10-25 smooth or roughened, acute, moderate orange yellow, delicate rodlike projections 3-5.5(-10) X 0.5(-1) µm, and with hyaline to moderate orange yellow walls up to 0.5 µm thick; and (2) broom cells with walls up to 1.5 µm thick and projections up to 1.5 µm thick, occurring at regular intervals and imparting a mottled appearance to the pileus surface.

STIPE corticated overall. CORTICAL HYPHAE 2-4.5 µm broad; with hyaline to moderate orange yellow walls up to 1 µm thick or with the wall completely occluding the lumen; dextrinoid. TRAMAL HYPHAE up to 10 µm broad; with hyaline walls up to 1 µm thick; dextrinoid. STIPE VESTURE of pale yellow, irregularly shaped broom cells with projections up to 11 µm long; frequent at the stipe apex, rare or absent elsewhere.

Gregarious on humus and leaves under *Robinia pseudoacacia*. Fruiting period uncertain.

Collections examined:

MICHIGAN: Gilliam 1509 & 1511 (holotype of *Marasmius robinianus* Gilliam).

Marasmius robinianus is closely related to *M. pulcherripes*. The unique combination of features defining *M. robinianus* includes the hemispheric to convex apricot-colored pileus, few lamellae (11-16 vs. 15-23 in *M. pulcherripes*), and a white to brilliant yellow stipe apex. The projections on both the hymenial and the cuticular broom cells are finer than in *M. pulcherripes*. The occurrence on leaves of *Robinia pseudoacacia* leaves is unusual for a *Marasmius*.

MARASMIUS section HYGROMETRICI ["Hygrometriceae"] Kühner,
Botaniste 25: 95. 1933.
Marasmius I Insititii I Setipedes a Foliicolae Quélet,
Fl. Mycol. France 311. 1888.

Type species: *Marasmius hygrometricus* Briganti, Fung.
Neap. 87. 1848.

Pileus small (<5 mm broad), plano-convex or convex, radially striate or not, thin, tough-membranous, dark in color. Odor and taste mild. Lamellae thin, or sometimes foldlike and then thick, few or lacking altogether, distant to remote, adnate or attached to a partial, adnate collar. Stipe thin (0.1 mm or less thick), pliant, glabrous, insititious. Rhizomorphs lacking, but sterile stipes present.

Spores obovate, nonamyloid. Hymenial cystidia fusoid-ventricose, often capitate or tapered, hyaline. Trama nonamyloid. Pileus cuticle a hymeniform layer of three types of cells: (1) broad, obovate or sphaeropedunculate broom cells closely ornamented with moderate brown, often acute warts, (2) rare cystidia similar to the hymenial cystidia, and (3) smooth cells similar to the broom cells in shape and size. Stipe cortex of roughened or spiculate thick-walled hyphae and occasional hyaline cystidia.

On leaves of deciduous trees.

With only one species here included:

25. MARASMIUS MINUTUS Peck, Annual Rep. New York State
Mus. 27: 97. 1873 (1875). FIG. 44
Marasmius capillipes Saccardo, Nuovo Giorn. Bot.
Ital. 8: 162. 1876.
Marasmius pyrinus Ellis, Bull. Torrey Bot. Club
8: 64. 1881.

PILEUS minute (0.1-3.2 mm broad); deeply convex or conic-convex at first, often with the margin incurved, remaining conic-convex or becoming plano-convex to plane, often with the disc slightly depressed; dry; dull; opaque; minutely roughened; not striate or distantly striate to sulcate inward to the disc; entire, lobed, or crenate; tough-membranous; drying and reviving rapidly. CUTICLE minutely velutinous; grayish brown (Natal Brown) when young, becoming moderate brown tinged pink (M&P 14B7-9, 15A7-10, Brownish Vinaceous), light grayish brown, light grayish yellowish brown, or light yellowish brown (Wood Brown), often darker (moderate brown, M&P 16A9-11, dark brown, Army Brown) on the disc and sometimes in the sulcae or on the extreme edge, darker overall (moderate brown, strong brown) upon drying. TRAMA indistinguishable. ODOR lacking. TASTE not tested.

LAMELLAE narrow and thin (less than 0.5 mm broad) or sometimes foldlike to ridgelike; distant to remote; few [1-6(-12)] or sometimes even lacking; equal; adnate or with a partial, adnate collar; pruinose overall; pliant; entire; straight; soon becoming crisped; minutely intervenose or not; sometimes forked halfway in to the stipe; white, yellowish white, or rarely purplish white.

STIPE 0.2-22 mm long, 0.1 mm or less in thickness; central; filiform; equal; curved, soon twisted and curled; dry; shining; opaque; solid; pliant; even or minutely longitudinally ribbed; glabrous; light yellowish brown, dark yellowish brown, deep yellowish brown (M&P 14F7-11), or pale yellow (near Cartridge Buff) at the apex, blackish brown or moderate reddish brown (Chestnut-Brown) below; insititious. RHIZOMORPHS absent. STERILE STIPES abundant; threadlike; tapered; upright; blackish brown.

SPORES white in mass; (4.5-)5.6-8.4 X 2.1-4.2 µm; pip-shaped, narrowly fusiform, or narrowly obovate. BASIDIA 15-22 X 4-7 µm; clavate, subclavate, or subcylindric; 4-spored or rarely 2-spored. BASIDIOLES fusiform with short necks and subcapitate or acute apices.

HYMENIAL CYSTIDIA 11-22 X 4-6 µm; lecythiform or fusoid-ventricose; subcapitate or rounded apically; with hyaline walls up to 0.5 µm thick; projecting up to 5 µm beyond the level of the basidioles; rare on the lamellar edges and faces.

TRAMAL HYPHAE interwoven and inflated up to 10 µm broad in the pileus; parallel, uninflated, and 1.4-3.0 µm broad in the lamellae; with thin, hyaline walls; nonamyloid.

PILEUS CUTICLE an irregular hymeniform layer of three types of cells: (1) subglobose, clavate, fusiform, sphaeropedunculate, obovate, pulvinate, or angular and irregular broom cells 7-21 X 2-18 µm, with closely spaced, often aligned, hyaline to moderate brown or deep brown, convex, conic, or cylindric warts or spines 0.2-1(-3) X 0.5-1 µm and with hyaline, moderate yellowish brown, or deep brown refractive walls up to 3 µm thick, usually tinted purplish white or light purplish gray in the lumen; (2) smooth cells of the same shapes and dimensions as the broom cells, with thin, hyaline walls; and (3) lecythiform or fusoid-

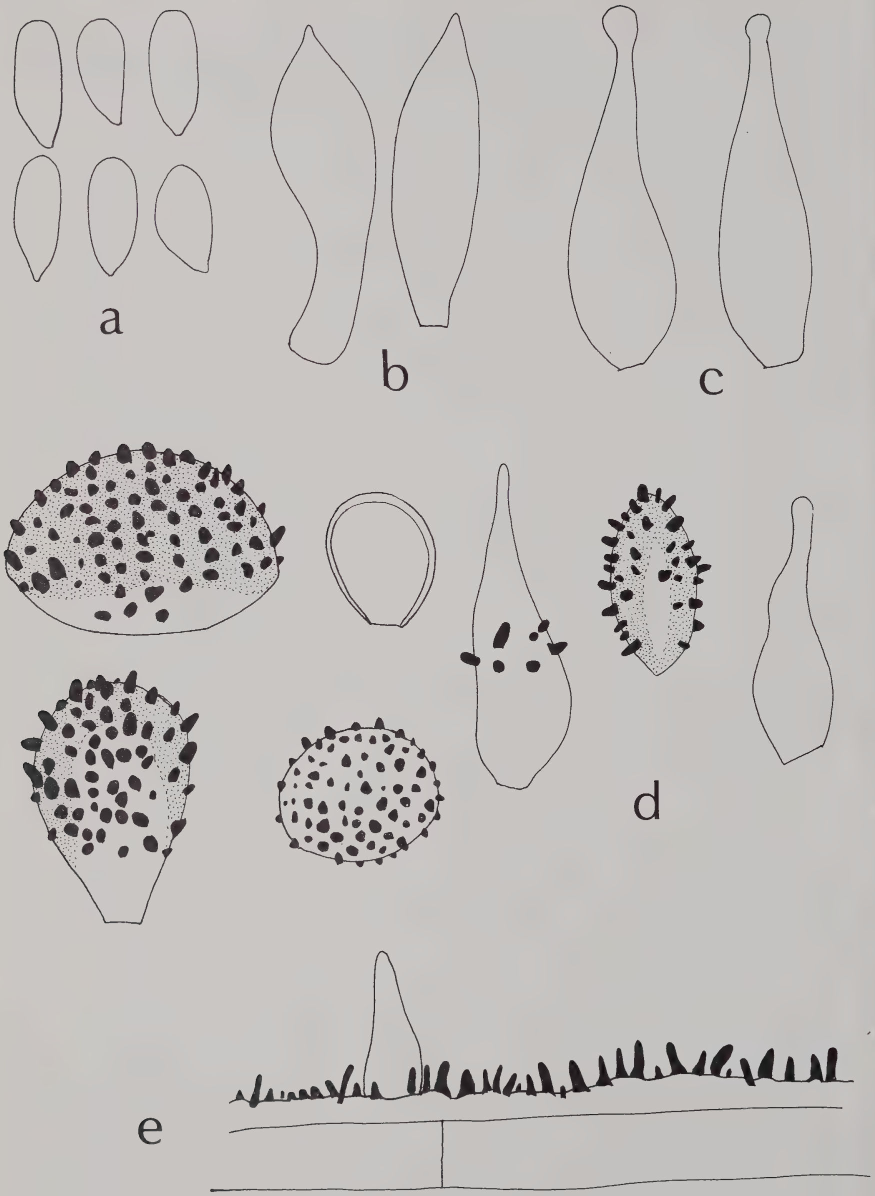

Figure 44. *Marasmius minutus*. Gilliam 1444. a. Spores, x2300. b. Basidioles, x1500. c. Hymenial cystidia, x1500. d. Cells from the pileus cuticle, x2300. e. Longitudinal section of the stipe cortex, x850.

ventricose cystidia 14-18 X 3.5-4.5 µm which are similar to the hymenial cystidia.

STIPE corticated only in pigmented portions, the superficial hyphae elsewhere hyaline and undifferentiated. CORTICAL HYPHAE 1.4-3.0 µm broad; with dark yellowish brown to dark brown walls up to 1.5 µm thick; nonamyloid; closely ornamented with short, hyaline to moderate yellowish brown spines up to 3 X 1 µm; sometimes with projecting hyaline, thin-walled lecythiform cells 8-14 X 3-5.5 µm with subcapitate or capitate apices. TRAMAL HYPHAE 1.5-3(-10) µm broad; with hyaline walls up to 0.5 µm thick, or sometimes with the wall occluding the lumen; nonamyloid.

Gregarious on curled, blackened leaves of *Fraxinus* in recently dried mucky openings of elm-ash swamps; rarely on well-decayed leaves and twigs of *Ulmus, Pyrus,* or *Populus*. Fruiting period: 16 June-15 November.

Collections examined:

ITALY: Saccardo, 1897, *Mycotheca Italica* (as *Marasmius capillipes,* BPI). CANADA: ONTARIO: Overholts 18503; Smith 4119, 26443, & 26451. UNITED STATES: MARYLAND: Hutchins, 24 Jun 1920 (BPI). MASSACHUSETTS: Singer, 18 Sep 1943 (as *M. capillipes,* FH). MICHIGAN: Brooks 1341 & 1356; Gilliam 1010 & 1444; Potter 5358; Shaffer 2526; Smith 33-774, 6619, 6838, 18842, 21791, 22031, 26039, 74587, & 77999. NEW HAMPSHIRE: Farlow, 6 Aug 1909 (FH). NEW JERSEY: Ellis, Jun 1880, North American Fungi 401 (holotype of *Marasmius pyrinus* Ellis, NY; isotypes, NYS, MICH, FH). NEW YORK: Peck, Aug (NY), 13 Aug 1910 (NY), 1874 (holotype of *M. minutus* Peck, NYS). PENNSYLVANIA: Stevenson, 15 Nov 1945 (BPI). VIRGINIA: Charles, 13 Sep 1939 (BPI). WISCONSIN: Dodge 1909 (NYS).

Although *Marasmius minutus* usually grows on curled, blackened leaves of *Fraxinus,* fruitings do occur occasionally on other substrates. These exceptions to the rule are frequent enough so that recognition of *M. pyrinus* does not seem justified, since the only difference between the type specimens of that name and of *M. minutus* is one of substrate. I have not seen the type of *M. capillipes;* however, one of Saccardo's exsiccati specimens identified as such and distributed several years after his publication of the species (ITALY: Vittorio, Sep 1897, Saccardo, *Mycotheca Italica,* BPI) agrees closely with *M. minutus.*

Although the specimen of *North American Fungi 401* now at NY was retained in Ellis' private herbarium and could therefore be considered the holotype of *Marasmius pyrinus*, there is very little if any usable material present. The best isotype appears to be that at MICH.

In Pennington (25) pale forms of *Marasmius graminum* will sometimes key to *M. minutus*. Although the former is usually found on grass and the latter on ash leaves, similarity in stature of the basidiocarps and in color of the pilei may make determination of dried material difficult. *M. graminum* has a free, usually complete collar, while *M. minutus* usually lacks a collar altogether, or if one is present, it is only partial and adnate to the stipe. In addition, hyphal walls of the stipe in *M. minutus* are spiculate, and those of *M. graminum* are smooth.

MARASMIUS section MARASMIUS

Marasmius tribus Mycena subtribus Rotulae Fries, Epicr. Myc. 384. 1838.
Marasmius I Insititii I Setipedes b Stipiticolae Quélet, Fl. Mycol. France 312. 1888.
Marasmius § *Mycena IV Insititii* Morgan, J. Mycol. 11: 244. 1905.
Marasmius section *Rotulae* Kühner, Botaniste 25: 98. 1933.

Type species: *Marasmius rotula* (Scopoli ex Fries) Fries, Epicr. Myc. 385. 1838.

Pileus small (<17 mm broad), obtusely convex to convex-depressed and often papillate or umbilicate with a dark spot at the center or not, striate or sulcate, thin, tough, white, light yellowish brown, moderate orange, or strong reddish brown. Lamellae thin, well-developed, few, distant, equal or with 1 or 2 short lamellulae, adnate to a free collar or rarely to a partial, adnate collar. Stipe thin, bristle-like, glabrous, insititious. Rhizomorphs or sterile stipes or both usually present.

Spores clavate to pip-shaped, nonamyloid. Hymenial cystidia lacking. Hymenial broom cells clavate to obovate, with numerous warts, present only on the lamellar edges. Trama nonamyloid or weakly dextrinoid. Pileus cuticle a hymeniform layer of obovate to sphaeropedunculate or rarely cylindric to clavate broom cells with numerous warts or short rodlike projections. Stipe cortex of smooth thick-walled hyphae. Stipe vesture lacking.

26. MARASMIUS GRAMINUM (Libert) Berkeley & Broome, Outl. Brit. Fungol. 222. 1865. FIGS. 42 & 45

Agaricus graminum Libert, Pl. Crypt. Arduennae 119. 1832.
Marasmius tritici Young, Phytopathology 15: 118. 1925.

PILEUS 2-9 mm broad; at first pulvinate, obtusely convex or plano-convex, then convex to plano-convex and often umbilicate, depressed, or papillate, in age almost plane or with an uplifted margin; dry; dull; opaque; smooth or minutely granular-roughened; distantly sulcate, less so in age; membranous; entire to crenate. CUTICLE minutely velutinous; at first deep orange (Orange-Rufous, M&P 6H12), strong brown to deep brown, dark reddish brown, strong reddish brown, deep reddish orange, or moderate orange (M&P 11C9, 10H8), often with a deep brown central dot, becoming moderate orange to light orange yellow (M&P 10F5) and progressively paler (M&P 6A12, 5A12, 10D3, 19E6) with age, usually retaining a darker central spot which fades with age, sometimes with the sulcae and the disc pale yellow (M&P 11H4), finally fading overall to yellowish white, often with a moderate brown central depression. TRAMA not distinguishable. ODOR and TASTE lacking.

LAMELLAE narrow (less than 1 mm broad); moderately thick; distant; few (8-13 reach the stipe); equal or sometimes with a single lamellula; adnate to a complete or partial, free collar or rarely to the stipe; fragile; entire; concave or straight, becoming subventricose; not intervenose; rarely forked; pale yellow to white, rarely with deep brown edges.

STIPE 13-36 mm long, 0.1-0.5 mm thick; central; terete; equal or tapering to the base; curved; dry; shining; translucent near the apex, opaque below; hollow; flexible at first, soon wiry and tough; even; glabrous; yellowish white (M&P 9B2) up to 2 mm downward, moderate reddish brown to blackish brown below; insititious. STERILE STIPES few to many on the surrounding substrate; tapered to an acute tip; often curled; deep blackish brown. RHIZOMORPHS lacking. BASAL MYCELIUM lacking, but the stipe often producing a black discoloration at the site of eruption from the substrate.

SPORES white in mass; 6.7-11.2 X 3.2-5.3 µm; pip-shaped, obovate, or broadly elliptic. BASIDIA 15-30 X 4-7 µm; clavate; 4-spored or rarely 2-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA lacking.

HYMENIAL BROOM CELLS 7-15 X 4-8.5 µm; broadly clavate, subglobose, cylindric, or obovate; with 4-20 hyaline to pale yellow, peglike, wartlike, or rodlike projections 1.5-5.6 X 0.5-1 µm; with hyaline to pale yellow walls up to 2 µm thick; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated (up to 11 µm broad) in the pileus; parallel to interwoven, uninflated, and 3-7.5 µm broad in the lamellae; with hyaline walls up to 0.5 µm thick; nonamyloid.

PILEUS CUTICLE a hymeniform layer of erect and subglobose, broadly clavate, or obovate, or repent and cylindric broom cells 4.2-20 X 6-14 µm, with 3-25 knoblike, wartlike, or rodlike, moderate orange yellow to light yellowish brown projections 1.2-4.2 X 0.5-1(-2) µm, and with hyaline to light yellowish brown walls up to 2(-4) µm thick.

STIPE corticated in the pigmented portions only, the superficial hyphae otherwise hyaline and undifferentiated. CORTICAL HYPHAE 2.5-6 µm broad; with deep yellowish brown to strong brown walls up to 1 µm thick; nonamyloid. TRAMAL HYPHAE 4-8 µm broad; hyaline; nonamyloid. STIPE VESTURE lacking.

Scattered, gregarious, or subcespitose on dead and dying portions of leaves and roots of Gramineae. Fruiting period: 14 June-9 September.

Collections examined:

BELGIUM: Heinemann, 26 Jun 1958 (BPI). ENGLAND: SURREY: Dennis, Sep 1950. LUXEMBOURG: Libert, *Plantae Cryptogamae Arduennae,* Fasc. II, 119 (isotype of *Agaricus graminum* Libert, BPI). UNITED STATES: DELAWARE: Commons, 4 Jun 1889 (NY). ILLINOIS: Young, 12 Jul 1924 (holotype of *Marasmius tritici* Young, BPI). INDIANA: Gilliam 933a. MAINE: Thaxter 3379 (FH). MASSACHUSETTS: Bigelow 15106 (MASS). MICHIGAN: Ammirati 4438 & 4970; Gilliam 799 & 862; Hoseney 2133; Mains 34-127. MINNESOTA: Young, 20 Jul 1928 (BPI). MISSOURI: Ellis & Everhart, North American Fungi, 2nd Series, 2301; Linder, 16 Aug 1928 (FH). NEBRASKA: Lloyd 27937 (BPI). NEW YORK: Murrill, 24 Jun (NY). NORTH CAROLINA: Beardslee 17011. OHIO: Cooke 30275. PENNSYLVANIA: Morgan 125 (IA). RHODE ISLAND: Curtis, 24 Jul 1964 (MASS). SOUTH CAROLINA: Ravenel, *Fungi Americani Exsiccati* 105 (NY, BPI). VERMONT: Burt, 19 Jun 1898 (BPI).

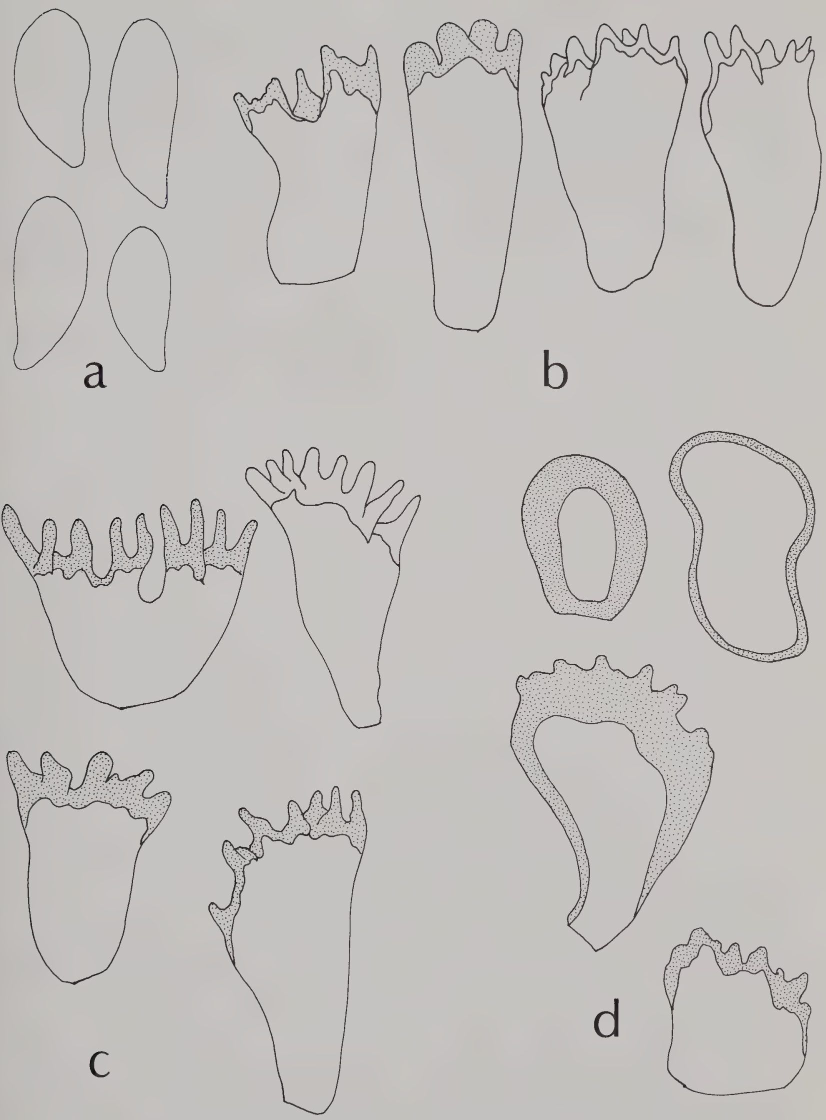

Figure 45. *Marasmius graminum*. a-e. x 2300. a. Spores, Gilliam 862. b. Broom cells from lamellar edge, Gilliam 862. c. Broom cells from pileus cuticle, Gilliam 933a. d. Broom cells from center of pileus cuticle, Gilliam 862.

Very little remains of the type of *Agaricus graminum*. The exsiccati specimen which I examined (BPI) lacked pilei; however, a stipe was present, and on its surface there were at least two spores (8 X 4 µm) resembling those of the species common on decaying grass in the United States and Europe. Although according to Singer (36) extensive variation occurs within this species at least in South America, the variation in the northeastern United States seems confined mostly to spore size and to the length and complexity of the projections on the cuticular broom cells.

Marasmius graminum may occasionally cause a disease of wheat and other grain crops (43).

27. MARASMIUS OLNEII Berkeley & Curtis, Ann. Mag. Nat. Hist. III, 4: 294. 1859.

"Pileus 1/3" across, convex, smooth, striate, pale rufous; stem 1-1/2" high, not a line thick, white, minutely pulverulent-tomentose, especially below; gills white, distant, minutely toothed, free, forming by their junction a little collar round the top of the stem." (Berkeley & Curtis, 1859)

SPORES 7-10 X 3-4 µm; elliptic. BASIDIA 21-25 X 4-6 µm; subclavate.

HYMENIAL CYSTIDIA not observed.

TRAMA nonamyloid to weakly dextrinoid, particularly below the cuticle.

PILEUS CUTICLE a hymeniform layer of subcylindric to subglobose broom cells with blunt cylindric projections up to 4 X 4 µm.

STIPE covered overall with long, nonamyloid hairs.

On hardwood twigs. Fruiting period unknown.

Collections examined:

RHODE ISLAND: Curtis 1821 (holotype of *Marasmius olneii* Berkeley & Curtis, K; isotype, FH).

Although Curtis' specimens are poorly preserved, certain features of the type suggest that *Marasmius olneii* is a distinct species belonging to sect. *Marasmius*. The combination of a white, pubescent stipe and cuticular cells with broad, blunt projections is unique. Section *Marasmius* is suggested by the collar and the nonamyloid trama.

28. MARASMIUS PRUINATUS Berkeley & Curtis, Ann. Mag. Nat. Hist. III, 4: 244. 1859.

"Pileus 1/2" across, campanulate, pale umber, pruinose, minutely wrinkled, stem 2" high, setiform, pale cinereous or tinged with reddish brown, shining with a satiny lustre; gills ochraceous, few, distant, interstices even. A thin white mycelium like a corticium spreads over the matrix." (Berkeley & Curtis, 1859).

SPORES 9-13 X 3 µm; lanceolate or narrowly elliptic.

PILEUS CUTICLE a hymeniform layer of cylindric to clavate broom cells ornamented with finely divided projections.

Gregarious on culms of grasses. Fruiting period unknown.

Collections examined:

NEW ENGLAND: Curtis 5064 (holotype of *Marasmius pruinatus* Berkeley & Curtis, K; isotype, FH).

According to Singer (39) *Marasmius pruinatus* is a form of *Marasmius graminum*. I have seen both the holotype and an isotype in the Curtis Herbarium. The holotype lacks spores, but spores from the Farlow material are longer than those of North American *M. graminum* (9-13 vs. 6.7-11 µm). Specimens of *M. pruinatus* are not well enough preserved to reveal much about the macroscopic appearance of the fungus. As a result, there is some disagreement between Singer and Dennis about the presence of a collar on the stipe. The most significant difference between *M. pruinatus* and *M. graminum* seems to be the finely divided projections on the cuticular cells of *M. pruinatus* which contrast with the broader, discrete projections of *M. graminum*.

29. MARASMIUS CAPILLARIS Morgan, J. Cincinnati Soc. Nat. Hist. 6: 194. 1883. FIGS. 46 & 47

PILEUS 1.5-15 mm broad; truncate-convex, bluntly conic, or squarely pulvinate, often umbilicate or papillate; dry; dull; opaque; granular-roughened or smooth; plicate-striate on the margin, smooth on the disc; crenate or lobed; pliant; reviving. CUTICLE minutely velutinous; light grayish yellowish brown (Avellaneous, Wood Brown), light yellowish brown (M&P 10C2, 11B-C3-4), or moderate yellowish brown (M&P 13D9) on the margin, usually yellowish white (M&P 9B1) to pale yellow (Cartridge Buff) on the disc and sometimes overall in age, occasionally with a

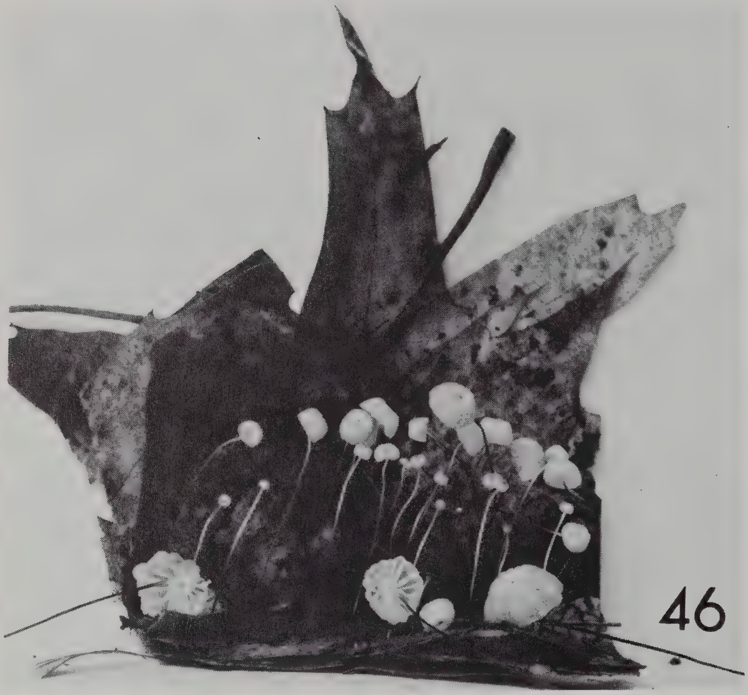

Figure 46. *Marasmius capillaris.* Shaffer 2568, x1. (courtesy of A. H. Smith)

minute central dark grayish yellowish brown dot. TRAMA thin (0.5-0.7 mm thick in the disc, scarcely distinguishable on the margin); yellowish white to white. ODOR mild or lacking. TASTE mild, sometimes with a bitter aftertaste.

LAMELLAE broad (1-2 mm broad); thin; distant; moderately numerous (13-20 reach the stipe); equal, or with one or two short lamellulae; adnate or arcuate-adnate to a free collar; pliant; entire; concave at first, soon straight; not intervenose; not forked; yellowish white.

STIPE 20-45(-110) mm long (long in relation to the pileus diameter), 0.1-0.3(-0.75) mm thick; central; terete; equal or enlarged slightly at the apex; straight or slightly curved; dry; shining; opaque; hollow; wiry; even; glabrous; concolorous with the darker portion of the pileus on the upper 1-3 mm, elsewhere blackish brown to black; insititious. STERILE STIPES usually abundant; tapered; acute; black. RHIZOMORPHS usually present but not usually conspicuous; 0.1-0.2 mm thick; twisted and curled; occasionally branched; black. BASAL MYCELIUM absent.

SPORES white in mass; 6.7-10(-11.2) X 2.8-5 µm; pip-shaped, narrowly obovate, or occasionally elliptic. BASIDIA 17-27 X 4-6 µm; clavate or subclavate; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA lacking.

HYMENIAL BROOM CELLS 5-21 X 4-14 µm; obovate, clavate, subglobose, or narrowly to broadly cylindric; with numerous convex, conic, or short-cylindric, hyaline to pale yellow deciduous warts or incrustations 0.5-3 X 0.5-1 µm; with hyaline walls up to 0.5 µm thick; nonamyloid or faintly dextrinoid.

TRAMAL HYPHAE 2.5-5 µm broad in both pileus and lamellae; tightly interwoven; uninflated; with hyaline, occasionally faintly incrusted walls up to 0.5 µm thick; nonamyloid or faintly dextrinoid.

PILEUS CUTICLE a hymeniform layer of clavate, subglobose, pulvinate, obovate, or rarely cylindric and lobed broom cells 4-28 X 4-23 µm, with numerous closely spaced, pale yellow or dark orange yellow, convex or cylindric warts or short spines 0.5-3 X 0.5-1(-2) µm and with hyaline to dark orange yellow walls up to 1 µm thick; nonamyloid or weakly dextrinoid.

STIPE corticated thinly overall. CORTICAL HYPHAE 1.5-3.5 µm broad; with hyaline to dark yellowish brown walls 0.5-1 µm thick. TRAMAL HYPHAE 1-3.5 µm broad; with thin, hyaline walls; dextrinoid (pale red in Melzer's reagent) or nonamyloid. VESTURE lacking.

Gregarious on decayed leaves, usually of oak, in deciduous woods, or rarely on needles in coniferous woods. Fruiting period: 14 June-10 October.

Collections examined:

CANADA: QUEBEC: Collins 5199 (FH). UNITED STATES: INDIANA: Gilliam 936. MARYLAND: Stevenson, 29 Aug 1937 (BPI). MICHIGAN: Gilliam 729, 817, 925, 936, 1448 & 1477; Kauffman, 20 Oct 1926; Potter 6374; Shaffer 2568; Smith 10796, 15073, 15212 & 63551. MINNESOTA: Weaver 1246 & 1735. NEW JERSEY: Ellis, Aug 1887 (NY). NORTH CAROLINA:

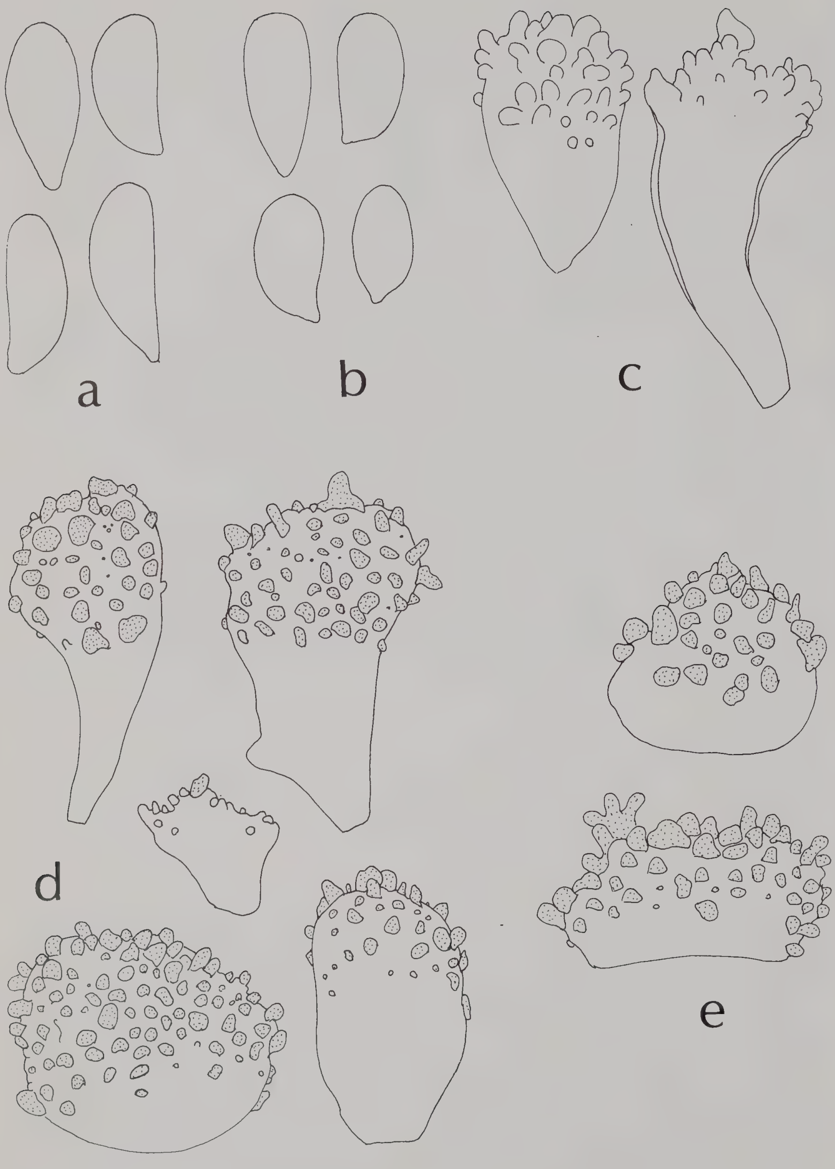

Figure 47. *Marasmius capillaris*. a-e. x2300. a. Spores, Shaffer 2568. b. Spores, Smith 63551. c. Broom cells from lamellar edge, Shaffer 2568. d. Broom cells from pileus cuticle, Shaffer 2568. e. Broom cells from pileus cuticle, Smith 63551.

Harrison 10968 & 11429. OHIO: Cooke 35612; Morgan, Oct 1890 (lectotype of *Marasmius capillaris* Morgan, IA), 14 Jun 1891 (paratype of *M. capillaris* Morgan, IA). PENNSYLVANIA: Kauffman, 6 Sep 1927. TENNESSEE: Smith 9721. VIRGINIA: Stevenson, 5 Sep 1937 (BPI). WISCONSIN: Mazzer 6276.

Since Morgan did not cite a holotype in the original description of *Marasmius capillaris* and no specimen in his collection is so marked, I am designating his collection of October 1890 as lectotype.

As long as the concept of *Marasmius capillaris* is restricted to specimens on oak leaves having bluntly conic pilei with pale discs and light yellowish brown margins as well as black capillary stipes, this species seems distinct from *M. rotula*. The following comparison applies to the majority of collections of both species:

Character	*M. capillaris*	*M. rotula*
Pileus shape	bluntly conic (flat on top, straight on sides)	pulvinate, then convex-depressed
Pileus color	light grayish yellowish brown on the margin, yellowish white on the disc	yellowish white or light yellowish brown overall
Stipe thickness	less than 0.3 mm	more than 0.3 mm
Stipe color	blackish brown to black	moderate brown to blackish brown
Substrate	leaves of various oaks	partially decayed logs, usually of hardwoods
Spore size	6.7-11.2 X 2.8-5 µm	6.2-9.5(-10) X 2.8-3.2 µm

Basidiocarps intermediate in many respects occur, however, on other substrates, such as beech leaves, well-decayed hardwood leaves other than oak, and even deer dung. For example, Smith 63551, on herbaceous debris, has spores and pilei characteristic of *M. capillaris* but stipes up to 0.75 mm thick and 11 cm long. Since spore size does not seem to be diagnostic except at the extremes of the range of variation in this group, specimens on oak leaves with the macroscopic features of *M. capillaris* but with spores only up to 8.4 µm long (e.g., Smith 10796, Gilliam 936 & 1448, Cooke 35612) or up to 5 µm broad (Weaver 1735) are retained in *M. capillaris*. Those with uniformly yellowish white or light yellowish brown pilei, small spores (averaging 7-9 X 3-3.5 µm), and moderate brown to blackish brown capillary stipes (e.g., Smith 63643, on well-decayed leaf mold) grade into the small light yellowish brown forms of *M. rotula* and are here considered variants of that species. A more satisfying definition of the limits of these two species will require more data from fresh specimens and perhaps culture work. Much of the variation in this group seems to correlate with the nature and extent of the substrate.

30. MARASMIUS ROTULA (Scopoli ex Fries) Fries, Epicr. Myc. 385. 1838. FIGS. 48 & 49

Agaricus rotula Scopoli ex Fries, Syst. Myc. 1: 136. 1821.

PILEUS 1.5-17 mm broad; hemispheric, pulvinate, or bluntly conic and often papillate at first, then convex or plano-convex and prominently umbilicate or shallowly to broadly depressed centrally; dry; dull; opaque; minutely granular-roughened; nearly even at first, soon plicate-striate or sulcate-striate 1/3-7/8 the pileus radius, deeply so in age; crenate or lobed; tough-pliant. CUTICLE glabrous or minutely velutinous; moderate yellowish brown to light yellowish brown in the primordial stage, becoming light yellowish brown or light grayish brown on the disc or overall, then yellowish white, light yellow (M&P 9-10 B2), pale yellow (Light Buff, Cartridge Buff), or pale orange yellow overall, in age yellowish white or pale orange yellow; with or without a central moderate brown (Prout's Brown), grayish yellowish brown (Bister), or moderate yellowish brown (Sayal Brown) spot. TRAMA moderately thick in the disc (0.25-1.5 mm thick), thin on the margin; white or yellowish white. ODOR mild or lacking. TASTE mild, sometimes with a bitter aftertaste.

LAMELLAE narrow at first, becoming moderately broad (1-3 mm broad), or sometimes broad from the first; thin; subdistant to distant; moderately numerous (16-25 reach the stipe); equal, or rarely with 1 tier of short lamellulae; adnate, uncinate, or sinuate and attached to a collar which may be broad or narrow and free from the stipe or adnate to it; tough-pliant; entire; straight or arcuate at first, sometimes ventricose in age; not intervenose; not

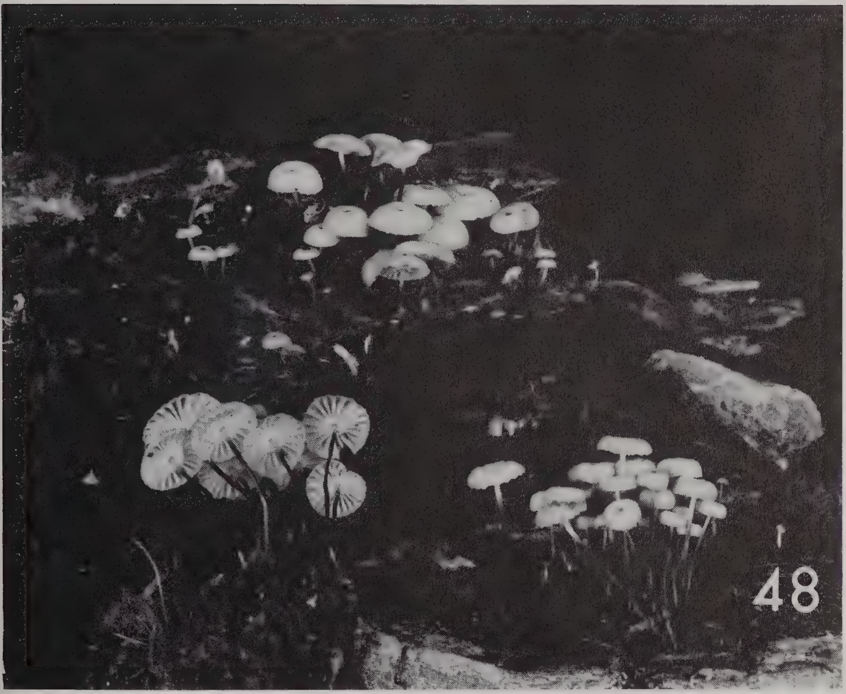

Figure 48. *Marasmius rotula.* Harrison 10511, x1.
(courtesy of K. A. Harrison)

forked; yellowish white or pale yellow.

STIPE 15-85 mm long, 0.3-1.0 mm broad; central; terete; equal or tapering to the base, which is sometimes subbulbous; straight or curved; dry; dull or shining; opaque in the pigmented portions, translucent at the apex; hollow; cartilaginous to wiry; even; glabrous; yellowish white or light yellow overall in the primordial stage, darkening from the base upward through light yellowish brown, light brown, moderate brown (Verona Brown), grayish reddish brown, dark grayish reddish brown (M&P 16A-C12), dark reddish gray (Light Seal Brown), brownish gray (Fuscous-Black), or dark yellowish brown, becoming dark brown or blackish brown in age but usually retaining one of the paler colors on the apical 1-3 mm. STERILE STIPES occasionally present; tapered; moderate brown to blackish brown. RHIZOMORPHS rare, abundant, or occasionally absent; usually wiry; straight or curled; often branched; 0.1-0.3 mm thick; moderate brown to blackish brown.

SPORES white or rarely pale yellow (Cartridge Buff) to pale orange yellow in mass; 6.2-9.5(-10) X 2.8-4.3 µm; obovate, narrowly elliptic, fusoid-elliptic, or pip-shaped. BASIDIA 21-31 X 4-17 µm; clavate, subclavate, or subcylindric; 4-spored. BASIDIOLES subfusiform.

HYMENIAL CYSTIDIA lacking.

HYMENIAL BROOM CELLS 7-32 X 2.5-20 µm; globose, subglobose, pulvinate, obovate, clavate, or broadly elliptic and often pedicellate; thin-walled; ornamented on the exposed surfaces with closely spaced, hyaline, light yellow, or moderate orange yellow, convex or bluntly conic warts or indistinct incrustations 0.2-1.5(-3) X 0.2-1 µm; not projecting; nonamyloid; present only on the lamellar edges.

TRAMAL HYPHAE interwoven and inflated up to 28 µm in the pileus; interwoven, 0.5-11 µm broad, and inflated up to 15 µm broad in the lamellae; with hyaline walls up to 0.5(-1) µm thick, or with the wall occluding the lumen; nonamyloid or sometimes with granular, oily, or refractive contents which are often weakly dextrinoid.

PILEUS CUTICLE a hymeniform layer of pulvinate, obovate, clavate, or broadly elliptic and sometimes lobed or pedicellate broom cells 7-30(-42) X 5-17(-28) µm, with hyaline to pale yellow walls up to 1 µm thick, ornamented above or almost overall with numerous closely spaced, hyaline, pale yellow, or moderate orange yellow incrustations, bluntly convex to convex warts, or short spines 0.2-3 X 0.2-1 µm or rarely smooth, nonamyloid, or sometimes with the projections dextrinoid.

STIPE corticated thinly overall. CORTICAL HYPHAE 3-5 µm broad; with hyaline to deep brown walls up to 1.5 µm thick; nonamyloid or weakly dextrinoid. TRAMAL HYPHAE 3-5 µm broad; with thin, hyaline walls; nonamyloid or sometimes pale red in Melzer's reagent.

Gregarious to cespitose on wood of deciduous or rarely coniferous trees, or sometimes on well-decayed leaf mold in deciduous woods. Fruiting period: 1 May-29 October.

Collections examined:

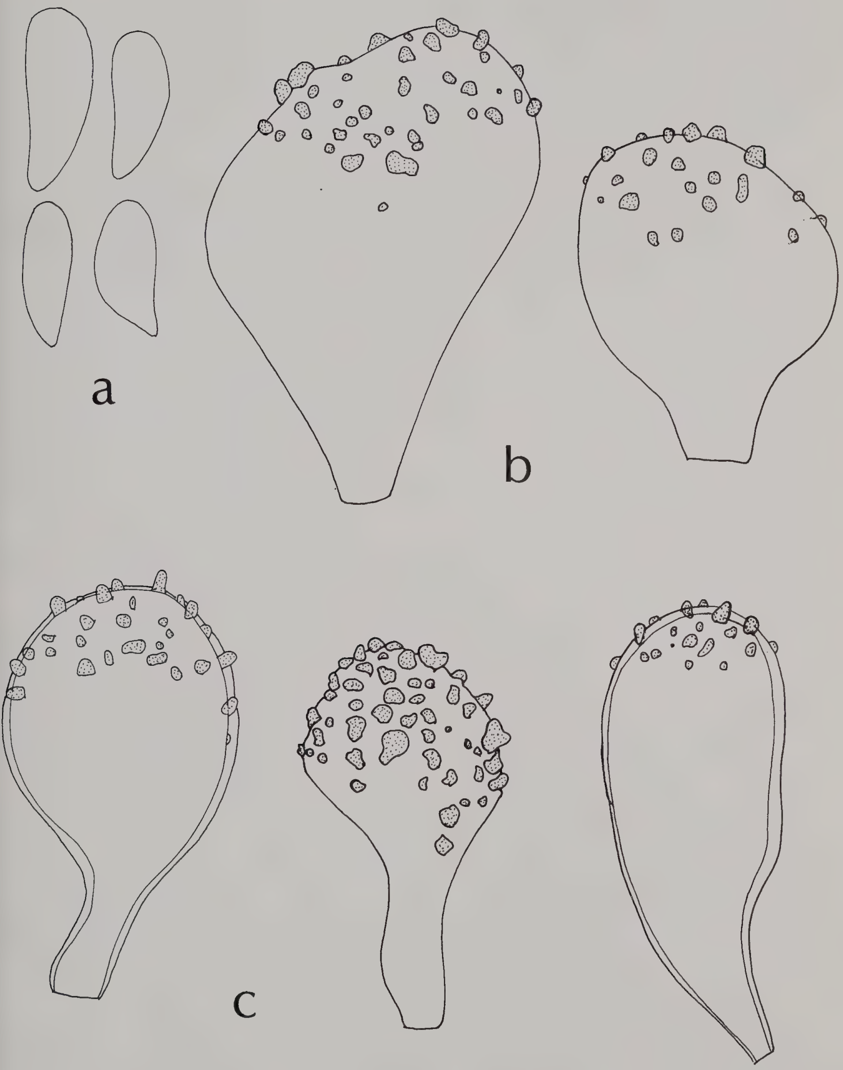

Figure 49. *Marasmius rotula*. Gilliam 532, x2300. a. Spores. b. Broom cells from pileus cuticle. c. Broom cells from lamellar edge.

BELGIUM: Westendorp & Wallays 1282 (NY). CANADA: NOVA SCOTIA: Harrison 7572; Wehmeyer 56. ONTARIO: Jackson 1669 (FH); Kelly 956. QUEBEC: Bigelow 5045 (MASS); Shaffer 5427. ENGLAND: SUSSEX: Austwick, 18 Jul 1950. FRANCE: AISNE: Shaffer 4204. OISE: Shaffer 4159. RHÔNE: Josserand, 30 Jun 1937. GERMANY: Krieger, *Fungi Saxonici* 225. ITALY: Bresadola, Jul 1891 (NY). SWEDEN: Romell, 21 Jul 1897 (NY). UNITED STATES: ALABAMA: Underwood, May 1897 (NY). CONNECTICUT: Underwood & Earle (NY); Stevenson 76923 (BPI). ILLINOIS: Shaffer 789; Stifler, 1940 (BPI). INDIANA: Cooke 32806; Stifler, Jun 1932 (BPI); Underwood, 1893 (NY). KENTUCKY: Underwood 27 (NY). MAINE: Bigelow 3155, 4383, 10185 (MASS), & 10235 (MASS). MARYLAND: Parker 1741 (BPI). MASSACHUSETTS: Bigelow 6710 (MASS). MICHIGAN: Ammirati 1598, 1800, 3375, & 4277; Bartelli 3126; Gilliam 492, 493, 530, 532, 558, 559, 759, 926, 1116, 1117, 1121, 1125, & 1451; Harrison 10379; Hicks 639 (FH); Hoseney 1247; Imshaug 3398; Mazzer 4811; Patrick 841 & 1053; Peters 1178; Potter 3301 (10 additional collections); Shaffer 2509; Smith 36508, 49586, 62448 & 63643. MINNESOTA: Weaver 1403 & 1416. MISSOURI: Ellis & Everhart, North American Fungi, 2nd Series, 2501 (NY). NEW HAMPSHIRE: Bigelow 11623 (MASS); Holmes 77 (MASS); Linder, Jul 1922 (FH). NEW JERSEY: Ellis & Everhart, North American Fungi 910 (BPI). NEW YORK: Bigelow 15024 (MASS); Rogerson 463 (NY); Shaffer 495. NORTH CAROLINA: Murrill & House 323 (NY); Shaffer 6246; Stanley 5792 (NY). NORTH DAKOTA: Brenckle, *Fungi Dakotenses* 173 (BPI). OHIO: Cooke 31922 & 40878; Fink, 8 Jul 1910 (BPI). PENNSYLVANIA: Henry, 25 Jul 1940 (FH); Murrill 1296 (NY); Parker, 4 Jul 1929 (BPI). RHODE ISLAND: Bigelow 14400 (MASS). TENNESSEE: Hesler 9114 (FH). TEXAS: Thiers 1915. VERMONT: Pringle 1334 (FH); Shaffer 3369. VIRGINIA: Murrill, 17-21 Jul 1904 (NY); Stevenson, 20 Jul 1905 (BPI). WISCONSIN: Gilliam 1189, 1229 & 1230; Shaffer 685.

Even in the absence of a type specimen, there is little doubt regarding the application of the name *Marasmius rotula*. European specimens I have studied show variation parallel to that in North American collections and belong to the same species.

Marasmius rotula varies in the shape, size, and color of basidiocarps. Some such differences are due to season, fluctuations in moisture, and stage of development. For example, collections in the spring on logs in oak-hickory woods tend to have yellowish white, convex-depressed pilei, while collections from the same areas in the fall often have light yellowish brown, obtusely convex pilei. This latter form persists in the woods for a long time during dry weather and is sometimes collected between periods of spore discharge. Many herbarium specimens are therefore sterile.

Spore size and shape are unusually variable, considering that *Marasmius rotula* is a small-spored species. Other features are not correlated with spore size differences, and so no justification exists for separating each variant as a different taxon. The usual size range for spores is about 6.5-8.5 X 3-3.5 µm. Collections with spores which do not exceed 8 µm in length (e.g., Ammirati 1800 & 1598) and those with spores up to 10 µm long (e.g., Bigelow 10185) occur fairly commonly. Spore print color should be extensively documented for this species, since Bigelow 10235 has a pale yellow to pale orange yellow spore print.

Some of the characters considered typical of *Marasmius rotula* have been found not to be constant. In particular, the dark central dot on the pileus is often lacking, and black rhizomorphs are conspicuous in some collections but not in others. The latter situation may be a function of collecting techniques.

For a discussion of the variants on beech leaves and decayed leaf mold, see the discussion under *Marasmius capillaris*.

EXCLUDED, EXTRALIMITAL, AND DOUBTFUL SPECIES

Marasmius acerinus Pk. New York State Mus. Bull. 5: 648. 1898 (1899). = *Micromphale foetidum* (Fr.) Singer, Lloydia 8: 182. 1945. Type specimen: NEW YORK: St. Lawrence Co.: Fine, 4 Aug 1909, Peck (NYS).

Marasmius albiceps Pk. Annual Rep. New York State Mus. 43: 21. 1889 (1890). = **Mycena albiceps (Peck) Gilliam, comb. nov.** Type specimen: NEW YORK: Manor, Sep 1899, Peck (NYS). Although the basidiocarps revive and the stipe is horsehair-like, *Marasmius albiceps* belongs to *Mycena*. Its spores are amyloid, and there is a well-defined subcutis of inflated dextrinoid hyphae, as well as an epicutis of narrow, hyaline, diverticulate hyphae. The lamellae are decurrent.

Marasmius albipilatus (Pk.) Singer,Ann. Mycol. 41: 129. 1943. = *Strobilurus albipilatus* (Pk.) Wells & Kempton, Mycologia 63: 377. 1971. I have not seen the type.

Marasmius albo-marginatus Clements, Bot. Surv. Nebraska 4: 20. 1896. Type not found. According to Pennington (25), the type consists of a single specimen, probably a *Mycena*.

Marasmius alienus Pk. New York State Botanist Rep. for 1909: 25. 1910. Type specimen: NEW YORK: St. Lawrence Co.: 7 Aug 1909, Peck (NYS). The type specimen is a *Collybia*. It has spores 10.5-12.5(-14) X 3-3.5 µm and abundant, projecting, tapered hymenial cystidia. The pileus cuticle consists of a dense layer of interwoven hyphae. The stipe is clothed overall with abundant, septate hairs.

Marasmius anomalus Lasch ex Rabenhorst in Klotzchii Herb. Vivum 1806. 1854. *M. anomalus* Lasch, of *Marasmius* sect. *Sicci*, probably occurs in North America but is not positively documented. The only possible record is a collection without data and without notes in the University of Michigan Herbarium.

Marasmius anomalus Pk. Annual Rep. New York State Mus. 24: 76. 1870 (1872). Non *M. anomalus* Lasch 1854. Type specimen: NEW YORK: Greene Co.: Catskill, Jul 1871, Peck (NYS). Pennington (25) published *Marasmius fasciatus* as a *nomen novum* for *M. anomalus* Pk. non Lasch. Apparently Pennington based his concept of the species on two Peck specimens labeled "*M. anomalus*", since his description in *North American Flora* cites features of both the type (spore size) and of another Peck collection (Caroga, Fulton, Aug) which differs in having fasciate basidiocarps. The type of *M. anomalus* Peck definitely belongs to *Collybia*, since it has a pileus cuticle of interwoven, smooth hyphae and nonamyloid trama. The basidiocarps are not fasciate. The name *Marasmius fasciatus* Pennington, however, has fallen into common usage for the fasciate fungus, which has dextrinoid trama, a hymeniform cuticle of smooth cells, and spores up to 11 µm long. As far as I can determine, the latter fungus is *Marasmius cystidiosus* (A. H. Smith & Hesler) Gilliam of *Marasmius* sect. *Globulares*. If transferred to *Collybia*, the epithet *anomalus* is again legitimate for the original Peck species.

Marasmius archyropus (Pers.) Fr. Epicr. Myc. 378. 1838. American material determined as *M. archyropus* (e.g., a collection from NY without collection data) has obovate spores 6.5-8.5 X 4-4.5 µm and filamentous cheilocystidia. A collection made by Robert Fries in Uppsala (NY) has pip-shaped spores 5-6 X 3-4 µm and clavate, nodulose cheilocystidia. If the Fries collection is representative of *M. archyropus*, American material does not belong to this species. Both have pileus cuticles of interwoven, smooth hyphae and thus belong to *Collybia*.

Marasmius atrorubens Berkeley, London J. Bot. 1: 138. 1842. This species has been reported by Morgan, but I have not found specimens from the northeastern United States.

Marasmius autumnalis Johnson, Bull. Minnesota Acad. Nat. Sci. 1: 358. 1880. Type specimen not found.

Marasmius biformis Pk. New York State Mus. Bull. 67: 25. 1902 (1903). = *Collybia biformis* (Pk.) Singer, Sydowia 15: 55. 1961 (1962). Type specimen: NEW YORK: Rensselaer Co.: Sandlake, Aug 1902, Peck (NYS).

Marasmius caespitosus Pk. Bull. Buffalo Soc. Nat. Sci. 1: 58. 1873 (1874). = *Collybia dichrous* (Pk.) Gilliam, which see. Type specimen: NEW YORK: Schoharie Co.: Richmondville, (no date), Peck (NYS).

Marasmius campanella (Pk.) Atkinson & House, Bull. New York State Mus. 65: 205. 1919. = *Crinipellis campanella* (Pk.) Singer, Lilloa 8: 492. 1942.

Marasmius candidus Fr. Epicr. Myc. 381. 1838. = *Marasmiellus albuscorticis* (Secr.) Singer, Lilloa 22: 300. 1951.

Marasmius caulicinalis ['*cauticinalis*'] With. ex Fr. Epicr. Myc. 383. 1838. = *Xeromphalina caulicinalis* (With. ex Fr.) Kühner & Maire, Bull. Soc. Mycol. France 50: 18. 1934.

Marasmius clavaeformis Berkeley, London J. Bot. 6: 316. 1847. Perhaps a *Collybia*. Curtis 474, Blake 729, Michener 358, and Ravenel 162 from the Curtis Herbarium (FH) do not belong to *Marasmius*, but as a result of the poor preservation of the specimens little additional information can be gained.

Marasmius confluens (Fr.) Ricken, Blätterp. Deutschl. 1:72. 1911. = *Collybia confluens* Fr. Epicr. Myc. 88. 1838.

Marasmius concinnus Ellis & Everhart, Proc. Acad. Philadelphia 1893: 441. 1894. Type specimen: DELAWARE: Mt. Cuba, 20 Sep 1893, Ellis & Everhart (NY).

The type specimen is immature, and no spores are available for study. *M. concinnus* seems closest to *Collybia* sect. *Subfumosae*. The cheilocystidia are 17-25 X 3.5-7 µm, with lateral or apical hyaline diverticula, and the pileus cuticle is formed of pale yellow diverticulate hyphae whose terminal cells are 8-11 X 6-10 µm.

Marasmius contrarius Pk. New York State Mus. Bull. 150: 34. 1910 (1911). = *Collybia umbonatella* Singer, Mycologia 35: 156. 1942 (1943). See *Marasmius umbonatus* Pk. Type specimen: NEW YORK: Essex Co.: N. Elba, Peck (NYS).

Marasmius cucullatus Ellis, Bull. Torrey Bot. Club 6: 76. 1876. Type specimen: NEW JERSEY: Gloucester Co.: Newfield, Oct 1875, Ellis, North American Fungi 702 (NY). The amyloid spores, the clavate, echinulate cheilocystidia, the dextrinoid trama, and the inflated cells of the pileus subcutis indicate that the type specimen is probably a *Mycena.*

Marasmius cucurbitula Montagne, Syll. Crypt. 141. 1856. Type specimen: OHIO: Franklin Co.: Columbus, Sullivant (PC). The type specimen is perhaps a *Collybia.* Its spores are 4.5-6 X 2-2.5 µm, nonamyloid, and narrowly pip-shaped. There are no cystidia. The trama is thick and nonamyloid, and the pileus cuticle is composed of interwoven, smooth hyphae.

Marasmius decurrens Pk. Annual Rep. New York State Mus. 24: 77. 1870 (1872). Non *M. decurrens* Montagne, Ann. Sci. Nat. Bot. IV, 1: 118. 1854. = *Marasmius resinosus* (Pk.) Sacc. Syll. Fung. 5: 522. 1877, *nom. nov.* for *M. decurrens* Pk. Type specimen: NEW YORK: Albany Co.: Albany Rural Cemetery, Jul-Aug 1870, Peck (NYS).

This species shows an unusual combination of features which exclude it from *Marasmius* and might form the basis for a new genus. The spores are amyloid. On the exposed surfaces of the basidiocarp (the gill edges, the pileus surface, and the stipe) are large, inflated cells exuding copious amounts of yellow resin. The pileus cuticle is composed of a hymeniform layer of such cells and occasional narrow laterally diverticulate hyphae. There are no gelatinous layers in the pileus and no long dermatocystidia characteristic of *Pseudohiatula,* a related genus with amyloid spores. *Gloiocephala,* which might also be related, does not have amyloid spores.

Marasmius dichrous Berkeley & Curtis, Ann. Mag. Nat. Hist. II, 12: 426. 1853. = **Collybia dichrous (Berkeley & Curtis) Gilliam, comb. nov.** Curtis' specimens at FH (SOUTH CAROLINA: Society Hill, Jul 1849, Curtis 2834, & Aug 1855, Curtis 5061 & 5065) have the pileus cuticle of interwoven hyphae with occasional clavate end cells; the voluminous, sometimes lobed or diverticulate cheilocystidia; and the branched stipe hairs characteristic of *M. caespitosus* Pk. and *M. fagineus* Morgan. All three names refer to a commonly collected taxon which belongs not to *Marasmius* but rather to *Collybia*.

Marasmius elongatipes Pk. Annual Rep. New York State Mus. 26: 66. 1872 (1874). = *Marasmius pyrrhocephalus* Berkeley, London J. Bot. 6: 316. 1847. Type specimen: NEW YORK: Wayne Co.: Savannah, Aug, Peck (NYS). See Gilliam (7).

Marasmius erythropus (Pers. ex Fr.) Fr. Epicr. Myc. 378. 1838. = *Collybia erythropus* (Pers. ex Fr.) Lange, Fl. Agar. Danica 2: 12. *pl. 45, f. 11.* 1936. This name has been used erroneously in the United States for several taxa, particularly *Marasmius sullivantii.*

Marasmius fagineus Morgan, J. Mycol. 11: 204. 1905. = *Collybia dichrous* (Berkeley & Curtis) Gilliam, which see. Type specimen: OHIO: Hamilton Co.: Preston, 17 Jul 1906, Morgan (IA).

Marasmius fasciatus Pennington, N. Am. Fl. 9: 270. 1915, *nom. nov.* for *M. anomalus* Pk. non Lasch. See discussion under *Marasmius anomalus* Pk.

Marasmius filopes Pk. Annual Rep. New York State Mus. 24: 77. *pl. 4, f. 27-29.* 1870 (1872). Type specimen: NEW YORK: Lewis Co.: Indian Lake, Oct 1871, Peck (NYS). There is too little left of the specimen to section, but a squash mount of pileus tissue shows narrow, laterally short-diverticulate hyphae and a few hyphal ends with broad diverticula. The stipe cortical hyphae have minutely roughened walls. Black rhizomorphs were not seen, and the stipe is not tough. *M. filopes* is nearest *Marasmiellus*.

Marasmius foetidus Sow. ex Fr. Epicr. Myc. 380. 1838. = *Micromphale foetidum* (Sow. ex Fr.) Singer, Lloydia 8: 182. 1945.

Marasmius graminis Murrill, N. Am. Fl. 9: 259. 1915. = *Marasmiellus tricolor* (Albertini & Schweinitz ex Fr.) Singer, Pap. Mich. Acad. Sci. 32 (1946): 128. 1948.

Marasmius haematocephalus (Montagne) Fr. Epicr. Myc. 382. 1838. Reports by Curtis and Morgan for the northeastern United States are based on specimens which do not fit Singer's description of this species.

Marasmius hirtipes Clements, Bot. Surv. Nebraska 4: 20. 1896. = *Marasmius pyrrhocephalus* Berkeley, London J. Bot. 6: 316. 1847. See Gilliam (7).

Marasmius impudicus Fr. Epicr. Myc. 377. 1838. = *Collybia impudica* (Fr.) Singer, Beih. Bot. Centralbl. Abt. B, 56: 163. 1936.

Marasmius insititius Fr. Epicr. Myc. 386. 1838. A North American fungus which has gone under this name has a pubescent stipe which is pale above and moderate brown below; a cuticle of interwoven, smooth hyphae; obovate spores 6-9 X 3-5 µm; and nonamyloid trama. A European specimen determined as *M. insititius* (GERMANY: Brandenburg, 14 Aug 1920, Sydow, *Mycotheca Germanica* 1406, MICH) has incrusted hyphae in the pileus cuticle, pip-shaped spores, and orange tints on the stipe. Neither of these concepts fits *Marasmius* as defined here; both taxa probably belong to *Collybia*.

Marasmius iocephalus (Berkeley & Curtis) Pennington, N. Am. Fl. 9: 271. 1915. = *Collybia iocephala* (Berkeley & Curtis) Singer, Lloydia 9: 116. 1946.

Marasmius lanatus (Schumacher) ex Morgan, J. Mycol. 11: 204. 1905. Morgan reports this species from Ohio, but his herbarium contains no specimen labeled as such. The description indicates that *M. lanatus* is a *Collybia*.

Marasmius leptopus Pk. New York State Mus. Bull. 67: 25. 1902 (1903). Type specimen: NEW YORK: Bronx Park, 11 Aug 1902, Peck (NYS). The type specimen is closest to *Collybia* sect. *Subfumosae*. No rhizomorphs were seen; the spores and trama are nonamyloid; and the pileus cuticle is composed of an irregular layer of repent to erect, hyaline, thin-walled hyphae whose terminal cells have numerous broad diverticula 2-4 X 2-6 µm. There are inconspicuous pleurocystidia and 2-6-diverticulate cheilocystidia. The stipe is covered with thick-walled, often diverticulate hyaline hairs.

Marasmius leucocephalus Montagne, Syll. Crypt. 142. 1856. = *Marasmiellus opacus* (Berkeley & Curtis) Singer, Lilloa 22: 300. 1951. Type specimen: OHIO: Franklin Co.: Columbus, Sullivant (PC).

Marasmius longipes Pk. Bull. Buffalo Soc. Nat. Sci. 1: 58. 1873 (1874). = *Marasmius pyrrhocephalus* Berkeley, London J. Bot. 6: 316. 1847. See Gilliam (7).

Marasmius longistriatus Pk. New York State Mus. Bull. 105: 25. *pl. S, f. 1-4*. 1905 (1906). = *Collybia biformis* (Pk.) Singer, Sydowia 15: 55. 1961 (1962) Type specimen: NEW YORK: Warren Co.: Bolton Landing, 28 Jul 1905, Peck (NYS).

Marasmius macrorrhizus Montagne, Syll. Crypt. 142. 1856.

= *Marasmius pyrrhocephalus* Berkeley, London J. Bot. 6: 316. 1847. See Gilliam (7). Type specimen: OHIO: Franklin Co.: Columbus, Jul, Sullivant (PC).

Marasmius magnisporus Murrill, Mycologia 4: 166. 1912. Type specimen: NEW YORK: Bronx, New York Bot. Gard., 28 Aug 1911, Murrill (NY). The type specimens have the aspect of *Marasmiellus*. The spores are pip-shaped or irregularly clavate and 11.5-17.5 X 3-4.5 µm. Cystidia are lacking in most sections but are sometimes present as projecting clavate cells on the lamellar edge. The pileus cuticle is composed of interwoven, hyaline hyphae.

Marasmius minutissimus Pk. Annual Rep. New York State Mus. 27: 97. *pl. 2, f. 27-28.* 1873 (1875). Type specimen: NEW YORK: Sullivan Co.: Forestburgh, Sep 1874, Peck (NYS). So little is left of the type that microscopic study was impossible. Judging from the macroscopic features visible, I would consider *M. minutissimus* to be an immature specimen of *Marasmius epiphyllus*.

Marasmius morganianus Sumstine, Mycologia 6: 35. 1914. Type not found. The description indicates a similarity to *M. pyrrhocephalus* Berkeley (7).

Marasmius multifolius Pk. ex Pennington, N. Am. Fl. 9: 270. 1915. Type specimen: NEW YORK: Essex Co.: Minerva, Jul, Peck (NYS). The unusual combination of amyloid spores with a nonamyloid trama and a pileus cuticle of interwoven, smooth hyaline hyphae does not fit any genus in the Collybiae or the Clitocybeae as defined by Singer (41). The aspect of the type specimens is closest to *Collybia*.

Marasmius nigripes (Schweinitz) Fr. Epicr. Myc. 383. 1838. = *Marasmiellus nigripes* (Schweinitz) Singer, Pap. Michigan Acad. Sci. 32: 130. 1946 (1948).

Marasmius nucicola McDougall, Trans. Illinois State Acad. Sci. 17: 84. 1925. Type specimen: ILLINOIS: 1924, McDougall. According to Smith (*North American Species of Mycena,* 1947), *Marasmius nucicola* is a synonym of *Mycena luteopallens* (Pk.) Sacc. The type, however, is now almost totally destroyed and could not be studied microscopically.

Marasmius nuptialis Morgan, J. Mycol. 11: 238. 1905. Type not found in the Morgan herbarium (IA).

Marasmius opacus Berkeley & Curtis, Hooker's J. Bot. Kew Gard. Misc. 1: 99. 1849. = *Marasmiellus opacus* (Berkeley & Curtis) Singer, Lilloa 22: 300. 1951.

Marasmius papillatus Pk. Annual Rep. New York State Mus.

24: 76. 1870 (1872). = *Collybia umbonatella* Singer, Mycologia 35: 156. 1942. Type specimen: NEW YORK: Rensselaer Co.: Sandlake, Aug 1871, Peck (NYS).

Marasmius papillosus Clements, Bot. Surv. Nebraska 4: 20. 1896. Type not found.

Marasmius perforans (Hoffman ex Fr.) Fr. Epicr. Myc. 385. 1838. = *Micromphale perforans* (Hoffman ex Fr.) Singer, Sydowia 2: 32. 1948.

Marasmius peronatus (Fr.) Fr. Epicr. Myc. 373. 1838. = *Collybia peronata* (Fr.) Singer, Beih. Bot. Centralbl. Abt. B, 56: 163. 1936. Although reported by earlier mycologists, this species probably does not occur in North America.

Marasmius phyllophilus Pk. New York State Mus. Bull. 116: 26. 1906. Type specimen: NEW YORK: Suffolk Co.: Wading River, 21 Aug 1906, Peck (NYS). The type specimen is a *Collybia* of sect. *Subfumosae*.

Marasmius polyphyllus Pk. Annual Rep. New York State Mus. 67: 286. 1897 (1898). = *Collybia polyphylla* (Pk.) Singer, Agaricales in Modern Taxonomy, ed. 2. 315. 1962. Type specimen: NEW YORK: Essex Co.: Minerva, Jul, Peck (NYS).

Marasmius praeacutus Ellis, Bull. Torrey Bot. Club 6: 76. 1876. = **Collybia praeacuta (Ellis) Gilliam, comb. nov.** Type specimen: NEW JERSEY: Gloucester Co.: Newfield, Jul & Aug, Ellis & Everhart, North American Fungi 402 (NY). *Collybia praeacuta* is a fairly common species on twigs in the hardwoods of the northeast. The type specimen has spores 4.5-6 X 2.5-3.5 µm and lacks cystidia. The pileus cuticle is composed of undifferentiated interwoven hyphae. On the stipe are numerous cylindric or tapered hairs 6-9 µm broad, with walls up to 1 µm thick.

Marasmius prasiosmus (Fr.) Fr. Epicr. Myc. 376. 1838. A North American species which closely parallels this European species is *Marasmius olidus* Gilliam (7, 8).

Marasmius putillus (Fr.) Fr. Epicr. Myc. 377. 1838. = *Collybia putilla* (Fr.) Singer, Beih. Bot. Centralbl. Abt. B, 56: 163. 1936.

Marasmius ramealis (Fr.) Fr. Epicr. Myc. 381. 1838. = *Marasmiellus ramealis* (Fr.) Singer, Pap. Michigan Acad. Sci. 32: 130. 1946 (1948).

Marasmius ramulinus Pk. Annual Rep. New York State Mus. 51: 286. 1897 (1898). Type specimen: NEW YORK: Albany Co.: Delmar, Aug, Peck (NYS). *Marasmius ramulinus* is close to *M. salignus* Pk.; both resemble

Marasmiellus. The type specimen of *M. ramulinus* has spores 7-10 X 3-4.5 µm, nonamyloid trama, cheilocystidia with a few hyaline diverticula or branches, and a pileus cuticle of interwoven hyphae with spirally thickened walls and occasional narrow diverticula. There are abundant clavate to cylindric hyaline hairs on the insititious stipe.

Marasmius resinosus (Pk.) Sacc. Syll. Fung. 5: 522. 1877, *nom. nov.* for *M. decurrens* Pk. non Montagne. Type specimen: NEW YORK: Albany Co.: Albany Rural Cemetery, Jul-Aug 1872, Peck (NYS). See *M. decurrens*.

Marasmius resinosus var. *niveus* Pk. New York State Mus. Bull. 67: 38. 1903. Type specimen: NEW YORK: Suffolk Co.: Port Jefferson, 6 Aug, Peck (NYS). See *M. decurrens*.

Marasmius resinosus var. *candidissimus* Pk. New York State Mus. Bull. 94: 40. 1905. Superfluous name for *M. resinosus* var. *niveus* Pk. given under the provisions of the Rochester Code.

Marasmius rigidus Montagne, Syll. Crypt. 143. 1856. = *Collybia dichrous* (Berkeley & Curtis) Gilliam. Type specimen: OHIO: Franklin Co.: Columbus, Sullivant (PC).

Marasmius rubrophyllus Pennington, N. Am. Fl. 9: 271. 1915. I have not studied the type specimen microscopically, but the description and the macroscopic appearance of the specimens are similar to *Collybia subnuda* (Ellis ex Peck) Gilliam, which see.

Marasmius salignus Pk. Annual Rep. New York State Mus. 35: 135. 1882 (1884). Type specimen: NEW YORK: Albany Co.: Bethlehem, Sep 1881, Peck (NYS). *Marasmius salignus* is similar to *M. ramulinus* Pk. in having nonamyloid trama and a pileus cuticle of diverticulate hyphae. Spiral thickening is also occasionally observed in the walls of the hyphae of the pileus, and the stipe hairs are similar. The spores of *M. salignus* are somewhat smaller than those of *M. ramulinus* (6-8 vs. 7-10 µm in length). Both probably belong in *Marasmiellus*.

Marasmius salignus Pk. var. *major* Pk. Annual Rep. New York State Mus. 41: 85. 1887 (1888). Type specimen: NEW YORK: Saratoga Co.: Gansevoort, Jul 1887, Peck (NYS). The overall aspect of the specimens and the large spores (12.5-18.5 X 4-6.5 µm) suggest a resemblance to *Marasmius magnisporus* Murrill, which see. The pileus cuticle is composed of smooth, interwoven hyphae. This taxon is not conspecific with

M. salignus var. *salignus*.

Marasmius scabellus Morgan, J. Mycol. 11: 202. 1905. = *Crinipellis setipes* (Pk.) Singer, Lilloa 8: 492. 1942. Type specimen: OHIO: Hamilton Co.: Preston, 1906, Morgan (IA).

Marasmius sclerotipes Bresadola, Fung. Trident. 12. *t. 11, f. 1.* 1881. = *Collybia cookei* (Bresadola) J. D. Arnold, Mycologia 27: 413. 1935.

Marasmius semihirtipes Pk. Bull. Buffalo Soc. Nat. Sci. 1: 57. 1873 (1874). = *Collybia spongiosa* (Berkeley & Curtis) Singer, Lilloa 22: 201. 1951. Type specimen: NEW YORK: Orange Co.: West Point, Jun 1872, Peck (NYS).

Marasmius semisquarrosus Berkeley & Cooke, Grevillea 6: 129. 1878. = *Collybia spongiosa* (Berkeley & Curtis) Singer, Lilloa 22: 201. 1951. I have not seen the type specimens.

Marasmius setipes (Pk.) Atkinson & House, New York State Mus. Bull. 205: 65. 1919. = *Crinipellis setipes* (Pk.) Singer, Lilloa 8: 493. 1942.

Marasmius spongiosus Berkeley & Curtis, Hooker's J. Bot. Kew Gard. Misc. 1: 100. 1849. = *Collybia spongiosa* (Berkeley & Curtis) Singer, Lilloa 22: 201. 1951.

Marasmius straminipes Pk. Bull. Buffalo Soc. Nat. Sci. 1: 59. 1873 (1874). Type specimen: NEW YORK: Albany Co.: Center, Oct 1872, Peck (NYS). The type specimen is closest to *Marasmiellus*. A glabrous, insititious stipe and pale, straw-colored rhizomorphs are present. The spores are 7-10 X 3-5 µm, and there are hyaline, clavate cheilocystidia with diverticula up to 6 µm long. The pileus cuticle consists of a single layer of narrow hyaline diverticulate hyphae.

Marasmius striatipes Pk. Annual Rep. New York State Mus. 24: 76. 1870 (1872). Type specimen: NEW YORK: Lewis Co.: Greig, Sep 1870, Peck (NYS). The combination of nonamyloid spores and trama with a pileus cuticle of interwoven undifferentiated hyphae suggests *Collybia*. The stipe, which is not insititious, is clothed with thin-walled, septate, filamentous hairs. If a transfer is made to *Collybia,* a new name will have to be designated, since the epithet *striatipes* is preoccupied (*Collybia striatipes* Velenovský, Céské Houby 2: 329. 1920).

Marasmius subnudus Ellis ex Peck, Annual Rep. New York State Mus. 51: 287. 1897 (1898).= **Collybia subnuda (Ellis ex Peck) Gilliam, comb. nov.** Peck's name is based on *Marasmius peronatus subnudus* Ellis, North American Fungi 909. 1883, a *nomen nudum.* I have seen one of the isotypes (NEW JERSEY: Gloucester Co.: Newfield, Ellis, NYS). This taxon has been called *Marasmius urens* by some but has a darker, tougher stipe and a less fleshy pileus than the acrid European species of that name. Both species belong to *Collybia* section *Vestipedes.*

Marasmius sulphureus Johnson, Bull. Minnesota Acad. Sci. 1878 (citation from Morgan, 1906). I have been unable to locate the type, but the description suggests *Marasmius strictipes* (Peck) Singer.

Marasmius tomentosipes Pk. Bull. Torrey Bot. Club 29: 71. 1902. = *Xeromphalina caulicinalis* (With. ex Fr.) Kühner & Maire, Bull. Soc. Mycol. France 50: 18. 1934.

Marasmius trullisatipes Pk. Annual Rep. New York State Mus. 66: 44. 1912 (1913). Type specimen: MINNESOTA: near Minneapolis, Peck (NYS). Owing to the state of decay of the basidiocarps and particularly the pileus cuticle, the taxonomic position of *M. trullisatipes* is difficult to assess. Its habit is that of a *Collybia,* but the amyloid spores and abundant, projecting fusiform hymenial cystidia suggest otherwise.

Marasmius umbonatus Pk. Bull. Buffalo Soc. Nat. Sci. 1: 58. 1873 (1874). = *Collybia umbonatella* Singer, Mycologia 35: 156. 1942 (1943). The epithet *umbonata* was preoccupied in *Collybia (C. umbonata* Peck, Bull. Torrey Bot. Club 31: 178. 1904).

Marasmius urens (Fr.) Fr. Epicr. Myc. 373. 1838. The species often called by this name in North America is *Collybia subnuda* (Ellis ex Peck) Gilliam. See *Marasmius subnudus.*

Marasmius varicosus Fr. Epicr. Myc. 376. 1838. There is a species of *Collybia* which, when it fruits in early spring with a dark brown rather than a reddish brown stipe, has been called *M. varicosus* in North America. The correct name for this taxon is *Collybia spongiosa* (Berkeley & Curtis) Singer or, if *C. spongiosa* and *C. semihirtipes* are thought to be separate species, the latter name. *M. varicosus* in Europe is figured as a fleshier fungus.

Marasmius velutipes Berkeley & Curtis, Ann. Mag. Nat. Hist. III, 4: 294. 1859. = *Collybia biformis* (Pk.) Singer, Sydowia 15: 55. 1961 (1962). Type specimen: SOUTH CAROLINA: Society Hill, Aug 1849, Curtis 2548.

I have seen the isotype at FH.

Marasmius vialis Pk. Annual Rep. New York State Mus. 51: 287. 1897 (1898). = *Marasmiellus tricolor* (Albertini & Schweinitz ex Fr.) Singer, Pap. Mich. Acad. Sci. 32 (1946): 128. 1948. Type specimen: NEW YORK: Saratoga Co.: Gansevoort, Jul 1897, Peck (NYS).

Marasmius viticola Berkeley & Curtis, Ann. Mag. Nat. Hist. III, 4: 294. 1859. = *Micromphale foetidum* (Sow. ex Fr.) Singer, Lloydia 8: 182. 1945. I have seen the isotype (ALABAMA: 1854, Curtis 4604) at FH.

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AN ANNOTATED INDEX FOR J. C. SCHAEFFER'S "BAVARIAN FUNGI."

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Summary

An alphabetical index to the taxa included by Schaeffer in "Fungorum... in Bavaria..."(1762-"1774") is furnished, together with notes on the origins of pre-existing binomials.

In the course of tracing early names used for fungi, I have had constant reference to Jacob Christian Schaeffer's "Fungorum qui in Bavaria... nascuntur" (1762-"1774"). This four volume series is of uncertain date, but the final volume, with it "index" must have been published in or just after 1774 (Petersen, 1975).

The entire work consists of excellent hand-colored lithographed plates, usually one per taxon, accompanied by the number, vulgar name and German description for each fungus. Finally, as part of the fourth volume, an "index" was furnished, consisting of a Latin name and description for each taxon, its text and plate numbers. Within the four volumes, then, Latin names are cited only in the last volume, and it is from its publication date that such names must be cited, not from the preceding plates or vulgar descriptions not accompanied by Latin names.

At the end of volumes one and two (all agarics) are indices to German names and taxonomic characters (by text numbers of the fungi). Many taxa are cross-indexed under two or more characters, and in this way these two indices can be used as a simple key to the included taxa.

Between the dates of appearance of the first volumes and the "index" of volume four, Scopoli's (1772) second edition of "Flora Carniolica..." was published. While his first edition (Scopoli, 1762) had employed polynomials, the second edition strictly used binomials. Examining those plates by Schaeffer available to him (but unnamed in Latin by Schaeffer), Scopoli supplied Latin binomials for selected taxa (Scopoli's was a local flora). These binomials, in turn, were observed by Schaeffer and used in the "index" to his volume four. In short, Schaeffer supplied illustrations and descriptions for some Scopoli names, then repeated these names later. In such cases, following what has become an informal convention, such names may be cited "[Schaeffer apud Scopoli]" followed by the post-1821 validating author.

It is evident that Schaeffer had a discerning eye, for he "split" taxa described by previous authors in several instances, e.g. his treatment of *Boletus bovinus sensu* Linnaeus and *sensu* Scopoli. Following the custom of the day, he also furnished a new epithet when it seemed appropriate, even though a "legitimate" epithet already existed and could be cited in synonymy. Beyond description of new taxa, Schaeffer's best contribution may have been to furnish binomial names to taxa previously known only by polynomials. Schaeffer used the binomials of only two other authors, Linnaeus (1753) and Scopoli, although many authors' publications were surely available in Regensburg, already a major scientific center.

At the conclusion of volume four, Schaeffer offered a concise listing of taxa, by genus, and then largely by groups of presumedly related taxa. Plate numbers and text numbers were listed, but no page numbers in the "index" - the only place where Latin names appeared. It is partly to remedy this awkward situation that the index below has been compiled.

It is hoped that this index will be of help in the use of Schaeffer's series now. In the event that the starting date for all fungi is changed to 1753, however, Schaeffer's publications will take on even more importance, and the roots of names he used will be needed for nomenclatural citation. For this reason also, the index has been gathered.

A few explanatory notes on the index are required.

1. In those cases where Schaeffer used a binomial of a preceding author, this is shown in the column labelled "Authority." LSP = Linnaeus, "Species Planatarum..." First Edition; Scop = Scopoli, "Flora Carniolica..." Second edition; each followed by the page in those works where the name appears.

2. When Schaeffer gave a binomial to a fungus previously known only by a polynomial, "nom. nov." appears as the authority, with no annotation.

3. When Schaeffer changed in some way (*nomen novum*, *comb. nov.*) an already extant binomial, "nom. nov." appears as the authority, but with an annotation (by number) to the relevant data.

4. When Schaeffer listed no synonyms, either binomial or polynomial, it is assumed that Schaeffer considered the taxon new to him, and "sp. nov." appears as authority. This

is true also when it is clear that Schaeffer separated two or more taxa from a "single" preceding name. In some cases the preceding name was retained for one taxon, and the segregate given a new name, assumedly as new species (e.g. his treatment of *Hydna imbricatum*), but often the original name was eliminated (e.g. his treatment of Linnaeus's *H. repandum*).

5. Page numbers refer to the location in the "index" to volume four, where the Latin name is cited for the first time, followed by the plate number (cf. bibliography for key to plate numbers and their locations in the volumes). Schaeffer already furnished an index to text numbers, which are often cited by post-1821 validating authors.

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flabelliformis	sp. nov.	81	113	
flavorufus	sp. nov.	83	123	19
fulvus	sp. nov.	89	262	
hepaticus	nom. nov.	82	116-120	
iuglandis	nom. nov.	75	101, 102	
luridus	sp. nov.	78	107	20
luteus	LSP: 1177	81	114	
mesentericus	nom. nov.	91	267	
multicolor	sp. nov.	91	269	22
olivaceus	sp. nov.	77	105	19
ovinus	nom. nov.	83	121, 122	
ramosissima	Scop: 470	79, 85	111, 127-129, 265, 266	
reticulatus	sp. nov.	78	108	20
rufus	sp. nov.	75	103	19
semiovatus	sp. nov.	92	270	
terreus	sp. nov.	92	315	21
ungulatus	nom. nov.	88	137, 138	23
variegatus	sp. nov.	90	263	
versicolor	LSP: 1176	88	136	

CLATHRUS

cancellatus	Scop: 485	136	Frontispiece	

CLAVARIA

acroporphyrea	nom. nov.	119	176	
albida	comb. nov.	116	170	24
aurea	sp. nov.	121	287	
corniculata	nom. nov.	117	173	25
cornuta	nom. nov.	121	289	
digitellus	nom. nov.	122	292	
flammea	sp. nov.	118	174	
flava	comb. nov.	118	175	26
flavescens	nom. nov.	120	285	27
gemmata	nom. nov.	122	290	28
hypoxylon	LSP: 1182	123	328	
laciniata	sp. nov.	122	291	
ligula	nom. nov.	116	171	
ophioglossoides	LSP: 1182	123	327	
pallida	sp. nov.	120	286	
pistillaris	LSP: 1182	115	169	
purpurea	nom. nov.	117	172	29
rubella	nom. nov.	119	177	
rufescens	sp. nov.	121	288	

ELVELA

albida	nom. nov.	101	151	
auricula	nom. nov.	103	156	
carnea	sp. nov.	106	164	
caryophyllaea	sp. nov.	115	325	
ciliata	Scop: 481	112	284	
clavus	sp. nov.	111	279	
coccinea	nom. nov.	100	148	
clavata	nom. nov.	100	149	
cornucopiae	nom. nov.	107	165	30
floriformes	sp. nov.	110	278	
foliacea	nom. nov.	113	319	
fuliginosa	nom. nov.	113	320	
hispida	nom. nov.	108	167	
hypocrateriformis	nom. nov.	102	152	
inflata	nom. nov.	102	153	
infula	nom. nov.	105	159	31
infundibuliformis	nom. nov.	110	277	
mesenterica	nom. nov.	108	168	
mitra	sp. nov.	105	160, 161	
monacella	nom. nov.	106	162	31
nigricans	nom. nov.	102	154	
ochracea	nom. nov.	103	155	
ochroleuca	sp. nov.	109	274	
pallescens	nom. nov.	114	322	
pallida	sp. nov.	112	282	
pileus	sp. nov.	111	281	

pulla	nom. nov.	104	158	
punctata	nom. nov.	107	166	32
purpurascens	sp. nov.	109	276	
purpurea	nom. nov.	114	323, 324	
pyxidata	sp. nov.	111	280	
ramosa	sp. nov.	106	163	
scutellata	nom. nov.	101	150	
spadicea	nom. nov.	112	283	
tubaeformis	nom. nov.	104	157	33
tubulosa	sp. nov.	109	275	
villosa	sp. nov.	114	321	

HYDNA

auriscalpium	LSP: 1178	96	143	
coralloides	Scop: 472	95	142	
crispum	sp. nov.	97	147, figs. 1, 7, 8	
cyathiforme	nom. nov.	93	139	
flavidum	sp. nov.	99	318	34
floriforme	sp. nov.	97	146, 147, figs. 2, 6	
gelatinosum	Scop: 472	96, 144, 145		
imbricatum	LSP: 1178	94	140	
pullum	nom. nov.	98	272	
rufescens	nom. nov.	95	141	34
squamosum	sp. nov.	99	273	35
striatum	sp. nov.	98	271	

LYCOPERDON

areolatum	Sp. nov.	130	190	
atrum	nom. nov.	131	329	36
coronatum	Scop: 490	127	183	
furfuraceum	nom. nov.	131	294	
echinatum	nom. nov.	128	186	
excipuliforme	Scop: 488	129	187, 292, 295	
gemmatum	nom. nov.	130	189	
maximum	nom. nov.	130	191	37
papillatum	nom. nov.	127	184	37
pyriforme	nom. nov.	128	185	
spadiceum	nom. nov.	129	188	
stellatum	LSP: 1184	126	182	

MUCOR

butyraceus	nom. nov.	132	194	
carneus	nom. nov.	133	195	38
fragiformis	comb. nov.	132	193	39
granulatus	nom. nov.	133	196	
ovatus	nom. nov.	132	192	
stemonitis	Scop: 493	133	197	

PEZIZA

crucibuliformis	Scop: 486	125	179	40
hirsuta	nom. nov.	124	178	
ollaris	sp. nov.	126	181	
sericea	nom. nov.	125	180	41

PHALLUS

caninus	nom. nov.	135	330
esculentus	LSP: 1178	135	199, 298-300
impudicus	LSP: 1179	134	196-198

ANNOTATIONS

1. A new name for *A. coccineus* Scop: 436. cf. *A. coccineus* Schaeff., nom. nov.
2. A new name for *A. chantarellus* LSP: 1171.
3. An orthographic varient from *A. alliaceus* Scop: 454.
4. A new name for *A. piperatus* Scop: 451.
5. A new name for *A. filamentosus* Scop: 441.
6. Several interesting notes on the history of this fungus are furnished by Schaeffer, as well as quotes from Roman poets.
7. A new combination of *Merulius degener* Scop: 462.
8. A new name for *A. limacinus* Scop: 422.
9. A new name for *A. betulinus* LSP: 1175.
10. A new name for *A. lubricus* Scop: 447. cf. *A. limacinus* Schaeff., nom. nov.
11. A new name for *A. lacteus* Scop: 458.
12. A new name for *A. dentatus* LSP: 1172.
13. A new name for *A. russula* Scop: 486.
14. *A. rufus* is listed in synonymy.
15. A new name for *A. membranaceus* Scop: 459.
16. A new name for *A. purpurascens* Scop: 424.
17. An elevation of one variety of *A. russula* Scop: 486.
18. A new name for *B. flabelliformis* Scop: 465. cf. *B. flabelliformis* Schaeff., sp. nov.
19. Several species segregated from *B. bovinus* LSP: 1177.
20. Several new species segregated from *B. bovinus* Scop: 463.
21. Elevation of varieties of *B. bovinus* Scop: 463.
22. A new name for *B. versicolor* Scop: 468. cf. *B. versicolor* (L.) Schaeff.
23. A new name for *B. igniarius* LSP: 1176.
24. A new combination of *Coralloides albida* Tourn. Inst.: 562.
25. A new name for *C. muscoides* LSP: 1183.
26. A new combination of *Coralloides flava* Tourn. Inst.: 562.
27. A new name for *C. arbuscula* Scop: 484.
28. A new name for *C. militaris* LSP: 1182.
29. A new name for *C. palmata* Scop: 483.
30. Is this an orthographic varient of *cornucopioides* Scop: 476?

31. This and *E. monacella* were segregated from *E. mitra* LSP: 1780, while Schaeffer's *E. mitra* is apparently a new species, for Linnaeus's *E. mitra* is not cited in synonymy.
32. A new name for *E. cornucopioides* LSP: 1181, apparently not Scop: 476.
33. A new name for *E. lubrica* Scop: 477.
34. *H. flavidum* and *H. rufescens* were segrated from *H. repandum* LSP: 1178.
35. A new species segregated from *H. imbricatum* LSP: 1178.
36. A new name for *Valsa tuberosa* Scop: 399.
37. These two species were segregated out of *L. bovista* LSP: 1183.
38. A new name for *Valsa miniatus* Scop: 399.
39. A new combination for *Valsa fragiformis* Scop: 399.
40. A new name for *P. lentifera* LSP: 1180.
41. A new name for *P. cyathiformis* Scop: 486.

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Vol. II. "1767" [1763]. pls. 101-200 + accom. text.
Vol. III. "1770" pls. 201-300 + accom. text.
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MYCOTAXON

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GIGASPORA MARGARITA, A NEW SPECIES IN THE ENDOGONACEAE

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In 1972, a soil sample from a soybean field on the Agronomy South Farm, University of Illinois Urbana, was wet-sieved and found to contain both white spores and yellow *Gigaspora* spores greater than 233 µm. Initially the white spores were considered immature spores of *Gigaspora gigantea* (Nicol. & Gerd.) Gerd. & Trappe (*Endogone gigantea* Nicol. & Gerd.). The white spores were collected and maintained in a pot culture. After three years of pot culturing on different hosts, yellow spores have not been found in pots inoculated with white spores. Furthermore, as determined from pot cultures started with yellow spores, the immature spores of *G. gigantea* are yellow and not white. We also found that the white-spored species differed in other respects from all of the five described species of *Gigaspora* (Gerdemann and Trappe, 1974).

Gigaspora margarita Becker & Hall, sp. nov. Figs. 1-6

Azygosporae singillatim in solo efformatae, globosae, 260-480 µm diametro, vel in solo compacto irregulares. Tunica sporarum levis, hyalina, e 4-8, raro 10 laminis, pluribus in maturioribus, efformata, 5-24 µm crassa, lamina quaque 1.5-4 µm crassa. Sporarum contentus albus, e guttulis oleosis minutis multis denique coalescentibus constitutus. Sporae directe per tunicam prope basim germinantes. Sporae terminales in hyphis sustinentibus productae. Hypha sustinens plerumque sub cellula instar suspensoris septata. Cellula instar suspensoris, 27-58 µm lata, hyalina vel pallide brunnea, levis, tunica 1-5 µm crassa, juxta sporam crassior. In solo vesiculae plerumque in hyphis spiratis singillatim vel in glomerulis compactis usque ad 20 numero, 22-35 µm diametro efformatae, juveniles tenuiter tunicatae, albae, maturiores pallide brunneae et prominentiis verruciformibus usque ad 4 µm altis, 5 µm latis ornatae. In radicibus endomycorrhizas cum arbusculis efformans.

Azygospores formed singly in the soil, globose, or irregular in compacted soils. Globose spores 260-480 µm diam. Spore wall smooth and hyaline, composed of 4-8, rarely 10, fused laminations, the number of laminations increasing with age. Spore wall 5-24 µm thick in mature spores, each lamination 1.5-4 µm thick. Contents of spores white, composed of many small oil droplets which tend to coalesce with age particularly in germination regions. Spore germination directly through the spore wall near the base. Spores terminal on the subtending hypha. Subtending hypha generally septate below the suspensor-like cell. Suspensor-like cell, 27-58 µm broad, hyaline to light brown smooth, walls 1-5 µm thick, thicker at the point of attachment to the spore. Vesicles formed in the soil usually on coiled hyphae, singly or in tight clusters of up to 20, 22-35 µm diam., thin-walled and white when young, turning light brown with age and becoming covered with warty projections up to 4 µm high and 5 µm wide. Forms endomycorrhizae with arbuscules.

DISTRIBUTION, HABITAT, AND SEASON: Known from agricultural fields in east central Illinois and from a virgin sand prairie in central Illinois. Probably widespread in the midwestern states and present in soil throughout the year. Reportedly common in Florida (T. H. Nicolson, personal communication) and recently collected in the Waikato area of the North Island, New Zealand (Hall, 1976). The Illinois isolate is also very similar or identical to a species collected by M. J. Hattingh in South Africa.

MYCORRHIZAL ASSOCIATIONS: This species formed arbuscular endomycorrhizae in pot cultures with *Allium cepa* L., *Glycine max* (L.) Merr., *Lycopersicon esculentum* Mill., *Sorghum sudanense* (Piper) Staph. and *Zea mays* L.

ETYMOLOGY: Latin, *margarita* (pearl), referring to the large pearly white globose spores.

COLLECTIONS EXAMINED: TYPE: ILLINOIS - Champaign Co., University of Illinois, Agronomy South Farm, field # 1101, inoculum from a soybean field mixed with autoclaved soil and planted with soybeans, spores retrieved February 9, 1976, Becker 01 (OSC).

Gigaspora margarita is readily distinguished from other members of the genus in having white spores (Fig. 1) with laminated walls (Fig. 2) and white clustered warty vesicles (Fig. 3).

The shape of the spores, vesicles and arbuscules (Fig. 4) of *G. margarita* are similar to those of *G. gigantea* (B spores, Gerdemann, 1955; Nicolson and Gerdemann, 1968), but the differences in the color and the structure of the spore wall readily distinguish the two species. *G. gigantea* is yellow and has a thin outer wall tightly covering an inner wall while *G. margarita* is white and has a spore wall consisting of several laminations.

G. margarita differs from *G. gilmorei* primarily in spore wall structure and spore germination. While *G. gilmorei* has a complex wall consisting of five layers of widely varying thickness which easily separates into an inner and outer wall (Gerdemann and Trappe, 1974), *G. margarita* has a wall with up to ten fused laminations 1.5 to 4 µm thick which do not readily separate when spores are crushed (Fig. 2). The innermost layers of the spore wall of *G. margarita* do not separate into peripheral compartments prior to germ tube penetration of the outer wall (Figs. 5 and 6).

G. margarita is like *G. calospora* except the globose spores of *G. margarita* are generally larger than 300 µm diameter and have laminated walls. The vesicles are usually borne in clusters rather than singly.

G. coralloidea and *G. heterogama* are brown-spored species and are readily distinguishable from the white-spored *G. margarita*.

AMENDED KEY TO THE SPECIES OF GIGASPORA:

1. Azygospores white 2
1. Azygospores not white 3

2. Spore wall with distinct laminations of near equal width; spores germinate without forming peripheral compartments; vesicles white . . . . *G. margarita*
2. Spore wall with inner and outer layers of unequal thickness; spores germinate from peripheral compartments; vesicles brown . . . . *G. gilmorei*

3. Azygospores yellow, smooth 4
3. Azygospores brown, with warts or minute spines 5

4. Globose spores less than 300 µm diam., pale yellow; vesicles smooth to knobby, formed singly . . . . *G. calospora*
4. Globose spores greater than 300 µm diam., bright yellow to greenish yellow; vesicles echinulate, formed in clusters . . . . *G. gigantea*

5. Globose spores greater than 300 µm diam., dark brown with hyaline warts; vesicles with coralloid projections . . *G. coralloidea*
5. Globose spores less than 300 µm diam., light brown with minute spines; vesicles smooth . . . . *G. heterogama*

FIGURES 1-6. *Gigaspora margarita.*

1. Mature azygospore, × 114.
2. Laminated spore wall, × 378.
3. Vesicles, × 378.
4. Arbuscule, × 378.
5. Section of a spore embedded in glycolmethacrylate resin showing young germ tube penetrating spore wall, × 378.
6. Late stage in spore germination, × 378. Note constriction of germ tube through the spore wall.

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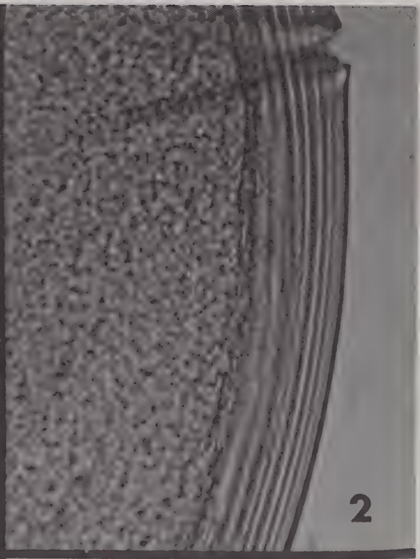
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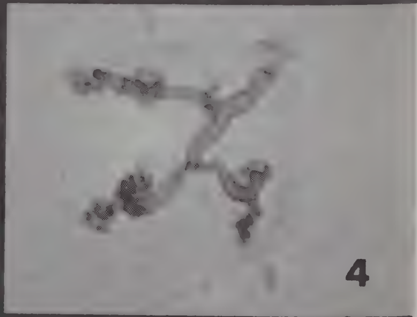
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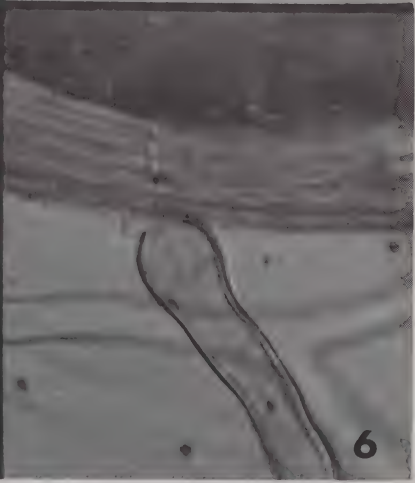
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ACKNOWLEDGMENTS: This work was supported by funds from the Illinois Agricultural Experiment Station. We wish to thank Dr. D. P. Rogers for preparing the Latin description and Vicki Toews for typing the camera-ready copy.

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MYCOTAXON

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STACHYBOTRYS RENISPORA SP. NOV.

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SUMMARY

Stachybotrys renispora Misra, a new species isolated from seeds of *Phlox drummondii* Hook., is described and illustrated.

A new species of *Stachybotrys* Corda was isolated in November, 1975 from seeds of *Phlox drummondii* Hook. which were placed over a wad of wet filter paper in a petri dish. The fungus first appeared on seeds and later grew and spread on the filter paper. It was readily isolated in pure culture and grown on malt extract agar medium. The specific epithet of the new taxon is based on the reniform shape of its conidia.

Stachybotrys renispora sp. nov. (FIG. 1)

Coloniae in agaro cum extracto maltoso composito crescentes die undecima 1.0-1.5 cm diametro, obscure griseae, velutinae. Conidiophori subhyalini vel pallide griseo-brunnei, subtiliter verrucosi, sympodialiter ramosi, septati; ramuli 20-50 µ longi, 2.3-3.2 µ diametro, ad apicem phialides 4-7 producentes. Phialides subhyalinae vel pallide griseo-brunneae, tunicis apicem versus obscurioribus, crassioribus, crebro minute verrucosi, 7.5-9.3 µ longae, parte latissima 3.0-4.5 µ diametro. Conidia reniformia, atra, levia, 5.2-7.0 × 3.5-5.2 µ.

Colonies on malt extract agar 1.0-1.5 cm in diam in 10 days, deep grey, velvety. Mycelium superficial and immersed, composed of 1.7-2.3 µ thick, hyaline, septate, sparsely branched hyphae. Conidiophores subhyaline to light greyish brown, minutely verrucose, sympodially branched, septate; branches 20-50 µ long, 2.3-3.2 µ im diam, bearing 4-7 phialides at their apices. Phialides subhyaline to light greyish brown, with darker and thicker walls at the apex, often minutely verrucose, 7.5-9.3 µ long, 3.0-4.5 µ in diam at the broadest part. Conidia reniform, black, smooth, 5.2-7.0 × 3.5-5.2 µ.

Type: PCM *555*, isolated from seeds of *Phlox drummondii* Hook., Gorakhpur, U.P., India, November, 1975. A dried petri dish culture of the type strain has been deposited in the Commonwealth Mycological Institute, Kew as IMI *199591*.

Stachybotrys renispora can be easily distinguished from *S. nephrospora* Hansf. (synonyms: *S. reniformis* Tubaki and *S. sinuatophora* Matsushima *fide* Jong & Davis, MYCOTAXON 3: 453.

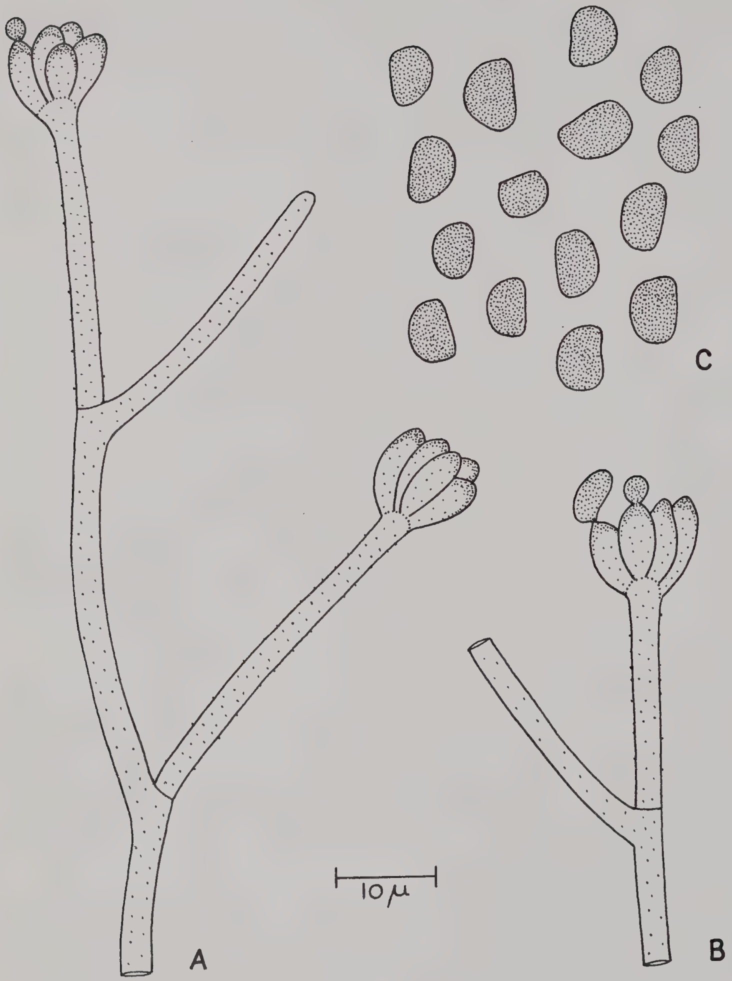

FIG. 1. *Stachybotrys renispora.* A and B, conidiophores with phialides. C, conidia.

1976) and from *S. oenanthes* M. B. Ellis, two other species with reniform conidia, on the basis of the smaller conidia.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. M. B. Ellis for examining the fungus and reviewing the manuscript, Dr. D. P. Rogers for the Latin diagnosis, and Prof. K. S. Bhargava for laboratory facilities.

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A NEW TREMELLA FROM ECUADOR

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Tremella dumontii sp. nov. (Fig. 1)

Fructificatio in humido molliter gelatinosa, alba, 2.2 cm lata usque 7 mm alta cum vesiculae laevigatae, lacunosae et leptodermae (circa 225 µm crassa); in sicco cornea, sordide alba; superficie inferioris alveolata, ad substratum late affixa; hymenio 50-60 µm crassa, basidia numerosa; zona hyalina externa gelatinosa usque 40-50 µm crassa; probasidia subglobosa, 11.0-13.5 µm diam; metabasidia ovoidea vel subovoidea, cruciatim septata, 17-21.5 X 10.5-13.5 µm diam; hyphae nodosae, 3.4 µm diam; sterigmata anguste cylindraceae, 2.0-2.5 µm diam, ad apicem inflata, usque 5 µm lato; conidiophori in hymenio interspersae; conidia subglobosa, 1.5-2.5 µm diam; basidiosporae subglobosae vel ovoidae, 8-10.5 X 5.5-8 µm diam, per repetitionem germinantes.

Holotype: Ecuador. 9 km from Limón on Limón-Mendez road, Prov. Morona Santiago. On unidentified wood, 3-VIII-1975. Leg. K.P. Dumont, S.E. Carpenter and P. Buriticá. Dumont EC-2090 (NY).

The species is named for Dr. Kent P. Dumont, collector of this and other new tremellaceous fungi from South America, recently described by the author.

Fructification soft gelatinous when wet, white, 2.2 cm X 7 mm in height, with inflated, smooth, hollow, bladder-like lobes having walls about 225 µm thick; drying rigid, dirty white, diminishing in volume by about 50 per cent; inferior surface alveolate, broadly attached to substrate by mucilaginous-gelatinous extensions of basidiocarp wall; hymenium 50-60 µm wide with abundant basidia, beneath a

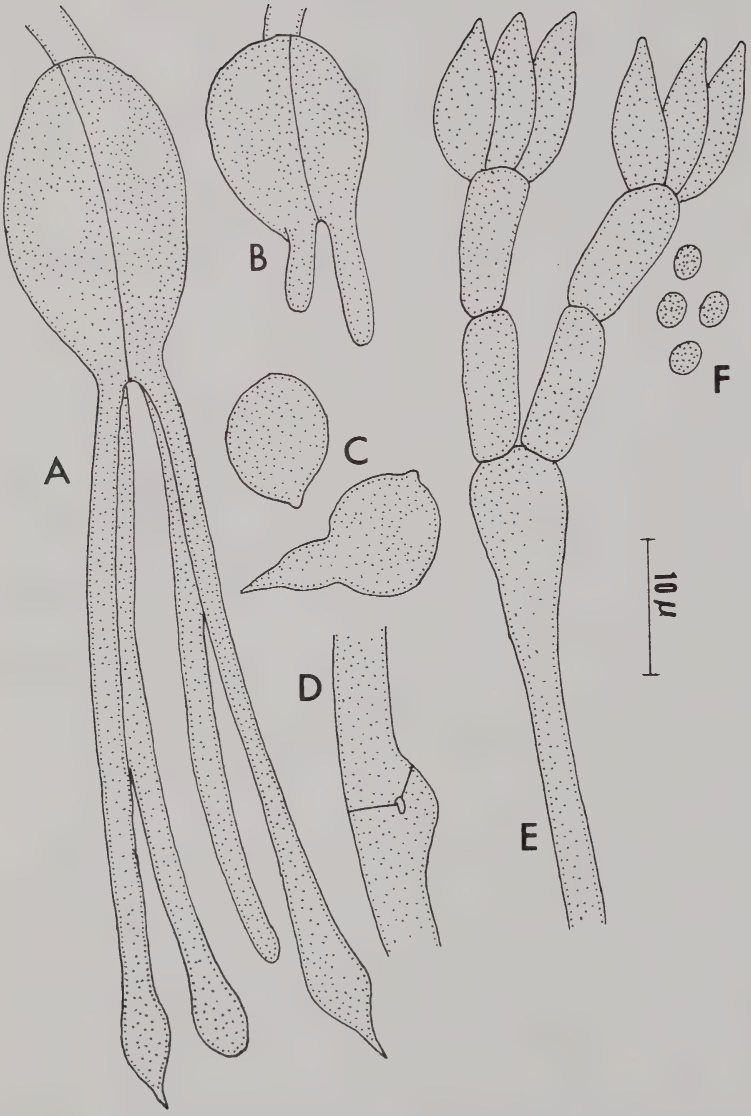

Fig. 1. Tremella dumontii (Dumont-EC 2090). A, mature metabasidium; B, 2-sterigmate, developing basidium; C, two basidiospores, one germinating by repetition; D, hypha with clamp connection; E, conidiophore; F, conidia.

hyaline, gelatinous external zone about 40-50 µm wide, penetrated by sterigmata; hyphae of subhymenium 3-4 µm diam with clamp connections; probasidia subglobose, 11.0-13.5 µm diam; metabasidia becoming cruciate-septate, ovoid to subovoid, 17-21.5 X 10.5-13.5 µm; sterigmata narrow cylindrical, 2.0-2.5 µm diam, apically inflated beneath the spiculum to about 5 µm; conidiophores interspersed in hymenium, forming apical clusters of phialides; conidia subspherical 1.5-2.5 µm diam; basidiospores subspherical to ovoid, 8-10.5 X 5.5-8.0 µm with prominent apiculi; germinating by repetition.

Of the neotropical species of *Tremella*, only *T. fibulifera* A. Möller bears a superficial resemblance to this in gross morphology, in the fresh state. The lobes of *T. fibulifera*, however, have a much softer, almost watery-gelatinous consistency, which upon drying, collapse and become reduced to a horny film with traces of pale yellow pigmentation. *Tremella volcanagua* Lowy from Guatemala (Lowy,1964) although much more massive than *T. dumontii* and dark in color, is not unlike it in its hollow lobes, hyaline external gelatinous zone and wide, clamped subhymenial hyphae.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. X.
CODINAEOPSIS GEN. NOV.

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ABSTRACT

A new genus, *Codinaeopsis* Morgan-Jones, is established to accommodate *Codinaea gonytrichoides* Shearer and Crane. The fungus is described and illustrated from a collection on dead *Rubus* stems made in Alabama.

INTRODUCTION

Examination of a collection of *Codinaea gonytrichoides*, made on dead stems of *Rubus* sp. from debris at the edge of a river, prompted questions concerning the suitability of its classification in *Codinaea* Maire. This species, whilst admittedly possessing a number of characteristics which link it to *Codinaea*, exhibits a peculiar arrangement of its conidiogenous cells on short collar hyphae which encircle a central setose stipe at intervals. In this respect it closely resembles a condition seen in *Gonytrichum* C.G. and F. Nees ex Pers., and which is unknown elsewhere among the hyphomycetes. This was recognized by Shearer and Crane (1971) in their choice of a specific epithet. *C. gonytrichoides*, in effect, occupies an intermediate position between *Codinaea* and *Gonytrichum*. To accurately reflect generic concepts and delimitations as they are currently accepted in the hyphomycetes it is my view that this organism should be placed in a genus of its own. A new generic name is therefore proposed for it herein.

TAXONOMIC PART

Codinaeopsis gen. nov.

Deuteromycotina, Hyphomycetes.

(Etym. *Codinaea* et. Gr. *opsis*, aspect)

Coloniae late effusae, appressae, albidae vel brunneae, setosae. Mycelium partim superficiale, partim immersum. Hyphae repentes, septate, laxe ramosae, laeves, subhyalinae vel pallide brunneae. Conidiophora numerosa, macronemata, mononemata, erecta, recta vel subrecta, laevia, atro-brunnea, sursum pallidiora, cum hyphae circumdata. Cellulae conidiogenae terminales et laterales, cylindricae vel flexuosae, monophialidicae vel polyphialidicae. Conidia hyalina, continua, cylindrica, curvata, hyalina, basi cicatrice conspicua, utrinque setula singula praedita, in capitulum mucosum incoloratum producta.

Species typica: *Codinaeopsis gonytrichoides* (Shearer and Crane) Morgan-Jones.

Colonies broadly effuse, appressed, whitish to brown, setose. Mycelium partly superficial, partly immersed in the substratum. Hyphae repent, septate, branched, smooth, subhyaline to pale brown. Conidiophores macronematous, mononematous, erect, straight or very slightly curved, septate, smooth, dark brown, paler towards the apex, bearing short encircling collar hyphae. Conidiogenous cells borne terminally and laterally on the collar hyphae or terminally on the main axis, cylindrical, monophialidic or polyphialidic, with collarettes. Conidia continuous, cylindrical, curved, hyaline, with a basal scar, bearing a single setula at each end, aggregated in mucilaginous masses.

Codinaeopsis gonytrichoides (Shearer and Crane) comb. nov. (Fig. 1).

≡ *Codinaea gonytrichoides* Shearer and Crane, Mycologia 63:245, 1971.

Colonies broadly effuse, somewhat appressed, whitish or cream to brown as numerous conidiophores are produced, setose. Mycelium partly superficial, parly immersed, composed of branched, repent, septate, smooth, subhyaline to pale brown hyphae, 3 - 5.5μm wide. Conidiophores macronematous, mononematous, scattered or gregarious in large groups, erect, straight or very slightly curved, dark brown, paler distally, apex frequently pale brown to subhyaline, producing laterally at the septa in the middle part short, encircling, somewhat nodose hyphae, slightly bulbous at the base, 160 - 380 X 4 - 8μm. Encircling hyphae occasionally grow out to form subhyaline to brown, sometimes setose branches. Conidiogenous cells mono or polyphialidic, borne terminally and laterally on encircling hyphae or sometimes terminally on the main axis, hyaline to subhyaline, smooth, cylindrical, straight or somewhat flexuous, with an apical funnel-shaped collarette or with several collarettes as a result of the production of a number of new conidiogenous loci by sympodial proliferation, 10 - 19 X 3 - 4.5μm, collarettes 1.5 - 2.5 X

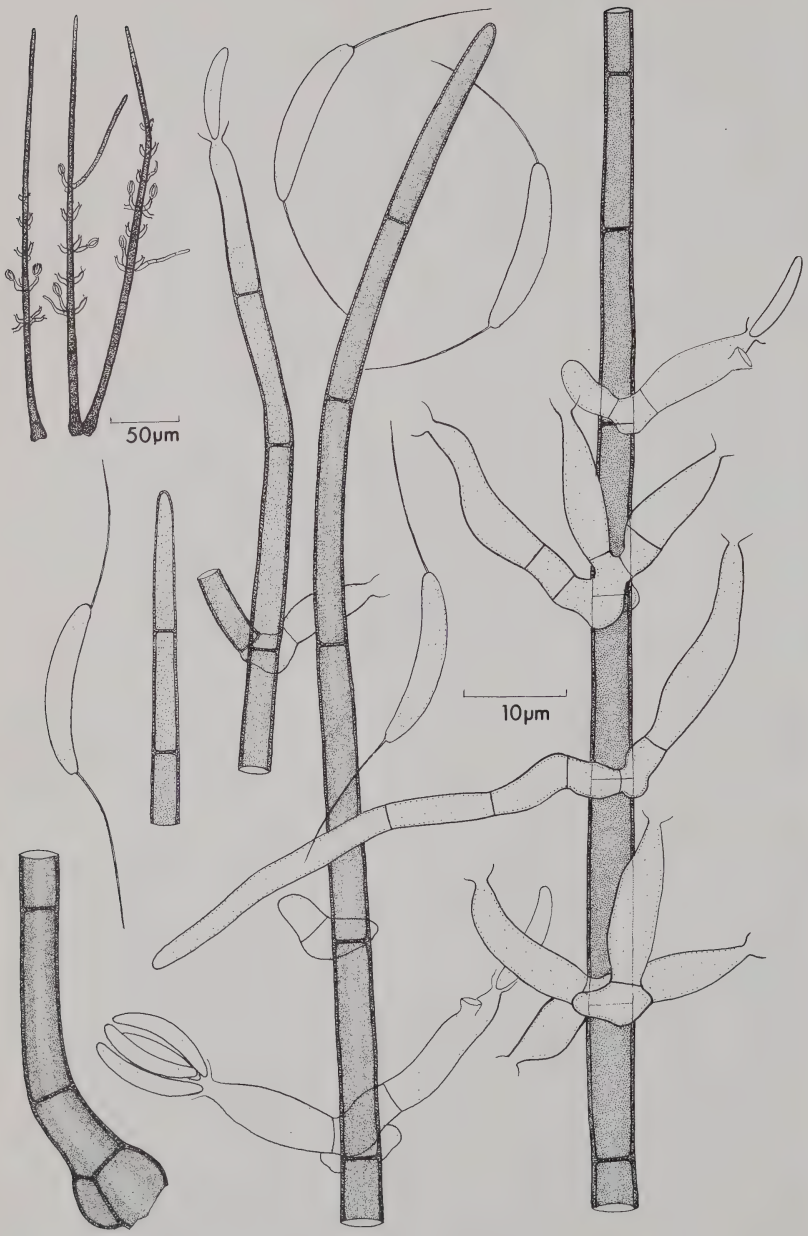

FIGURE 1. *Codinaeopsis gonytrichoides*; conidiophores and conidia.

1.5 - 3µm. Conidia continuous, cylindrical, curved, hyaline, obtuse at each end, guttulate, with a basal scar, bearing at the apex and to one side of the basal scar a simple, curved, setula, aggregated at the collarettes in mucilaginous masses, 10 - 15.5 X 1.5 - 2.5µm, setula 5 - 13µm long.

On samaras of *Acer* sp., fruit of *Carya* sp., leaves of *Castanopsis cuspidata*, seeds of *Liriodendron tulipifera*, stems of *Rubus* sp., and balsa-wood; North America and Japan.

Specimen examined: on dead stem of *Rubus*, Chewacla State Park, Lee County, Alabama, U.S.A., April 4, 1974, W. C. Blair, AUA, BPI.

The type collection was made on dried fruit of *Carya* sp., in a swampy habitat in Illinois. Two other collections were made in that state and one on submerged balsa-wood in a Maryland river (Shearer and Crane, 1971). Yokoyama (1975) reported a collection from Japan.

DISCUSSION

Codinaeopsis has, in addition to possession of distinct encircling hyphae borne at intervals on the main conidiophore axis, another characteristic in common with *Gonytrichum*. The nodose hyphae occasionally grow out to form long, setiform, sterile branches. The only real differences between the two genera lie in the facts that the conidiogenous cells of *Codinaeopsis* bear collarettes and are sometimes polyphialidic, and that its conidia are allantoid in shape and bear setulae.

In *Codinaea* the conidiogenous cells arise terminally and singly on simple conidiophores, in almost all cases independently of any seta. In seven species of the genus setae are absent. Only in the *Codinaea* state of *Chaetosphaeria dingleyae* Hughes, were rarely the setae become fertile apically, in *Codinaea maharashtrensis* Pirozynski and Patil, where the conidiogenous cells occasionally arise in tufts from the basal cells of the setae, and in *Codinaea apicalis* (Berk. and Curt.) Hughes and Kendrick and *Codinaea glauco-nigra* (Cooke and Ellis) Hughes and Kendrick where they are borne on the setae, on short lateral branches, or exist as fertile apical cells, is there any association between a central seta and the conidium bearing structures. It is possible that the arguments advanced here for segregating *C. gonytrichoides* in a separate genus might also apply to the latter two species.

Menisporopsis Hughes is distinguished from *Codinaea* because a synnema of conidiophores is formed surrounding a central seta in the former. This in spite of the fact that a mononematous versus a synnematous arrangement has been recognized as an insubstantial character on which to base generic distinctions. That *Codinaea obesispora* Hughes and Kendrick possesses a synnematous arrangement to its conidiophores, yet is not classified in *Menisporopsis* because of the absence of seta, underlines the problem of providing a fully satisfactory generic home from some species in this complex.

It is arguable that *C. gonytrichoides* has as much if not more in common with *Gonytrichum* than it has with *Codinaea*. Equally it has perhaps no more in common with *Codinaea* than do members of *Menisporopsis*, a segregate currently accepted as useful. The justification for erecting a new genus for it is therefore evident.

ACKNOWLEDGMENT

I thank Mrs. Elaine Gillam Turner for her typing of this manuscript.

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KUEHNIELLA, A NEW GENUS OF THE GYMNOASCACEAE

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Summary

A fungus, originally described as a species of *Myxotrichum*, is redescribed and a new combination is proposed: *Kuehniella racovitzae* (Lagarde) Orr.

Kuehn (6) discussed species of *Gymnoascus* and *Myxotrichum* listed in the literature with comments about their possible relationships. Orr et al. (19, 20) monographed the two genera, excluding numerous species assigned to them by many investigators.

Among the excluded species was one described by Lagarde (14) as *Myxotrichum racovitzae*. The relationship of this fungus was confused because Lagarde also referred to it as *Gymnoascus racovitzae* in the same paper. He did not discuss any characters which would relate this fungus to either of the genera. Orr et al. (19, 20) suggested that this species might be closely related to *Arachniotus* as it was then accepted by many mycologists.

Attempts were made to obtain Lagarde's original material, but none apparently exists. Five strains of a fungus isolated from different areas and habitats in the United States were determined by the author to be the same as that described by Lagarde. They are characterized below.

Kuehniella gen. nov.

Gymnothecia alba globosa, ad peripherum appendicibus spiralibus praedita, confluentia; elementa gymnothecia componentia eis hypharum vegetarum similis, laxe intertexta et ascos circumdata; asci plerumque sphaerici hyalini evanescentes octospori; ascosporae globosae glabrotunicatae; status asexualis in forma arthroaleuriosporarum et aleuriosporarum; hyphae "racquet" dictae praesentes.

Species typica: *Myxotrichum racovitzae* Lagarde

Etym: After Dr. H.H. Kuehn, Mycologist.

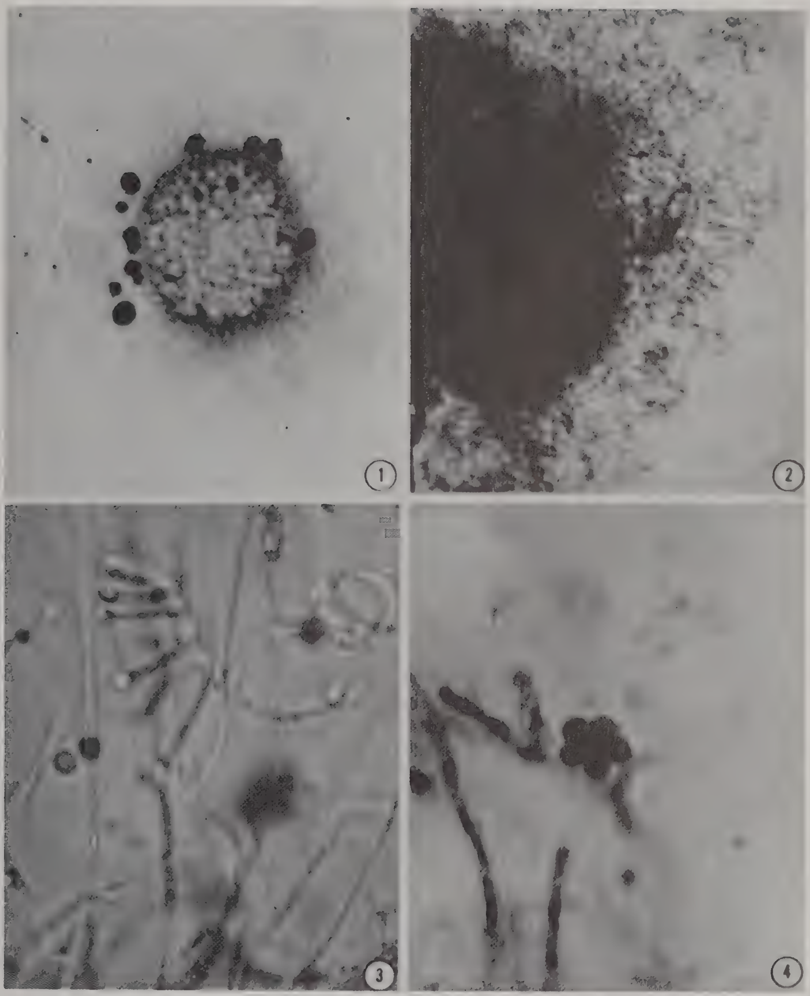
Gymnothecia white, globose with spiral appendages at the periphery, confluent. Elements comprising the gymnothecia similar to those of the vegetative hyphae, loosely interlaced to enclose the asci. Asci mostly spherical, hyaline evanescent, 8-spored. Ascospores globose, hyaline, with walls smooth. Asexual state represented by arthroaleuriospores and aleuriospores. Racquet hyphae present.

Kuehniella racovitzae (Lagarde) Orr, comb. nov.

= *Myxotrichum racovitzae* Lagarde, Arch. Zool. Expér. Génér. 53:280. 1913.

= *Gymnoascus racovitzae* (Lagarde) Lagarde, Arch. Zool. Expér. Génér. 53:281. 1913. (lapsus calami?)

Gymnothecia white, mostly spherical, 50-1400 µm diam, excluding the spiral appendages, confluent. Spiral appendages forming at the periphery of the gymnothecia, variable in number, length and in number of turns per spiral. Elements of the gymnothecia are similar to the somatic hyphae and surround the asci loosely. Asci hyaline, spherical, 6.8-11.4 µm diam or oval to ellipsoid, 5.7-7.6 x 8.1-11 µm, occasionally stipitate, the wall evanescent, 8-spored. Ascospores hyaline, globose, 2.3-4.2 µm dia., with thick, smooth walls. Asexual spores of two types: (1) aleuriospores that are hyaline, more or less pyriform, 2.2-4.2 x 5.6-6.7 µm and (2) arthroaleuriospores that are hyaline, more or less cylindrical, 1.9-2.9 x 4.2-9.5 µm. Racquet hyphae sparse, when present not in association with the gymnothecia.



Figs. 1-4. *Kuehniella racovitzae*. All material stained with cotton-blue, all magnifications approximately x1000.
Fig. 1. Gymnothecium packed with young asci and ascospores.
Fig. 2. Gymnothecium showing spiral appendages at periphery.
Fig. 3. Coiled appendages and ascospores.
Fig. 4. Ascospores in the ascus.

Type habitat: On rotting wood found in a cave, France.

Neotype specimen (dessicated): 0-3436 (Weeks, KCFS 62-4739, ATCC 28557, NRRL 6154) isolated from a lesion on a dog, Mission, Kansas. Other specimens examined: 0-3212 (ATCC 32467) isolated from sputum, Kansas City, Kansas; 0-3636 (ATCC 32468) isolated from mouse dung, Fruita, Colorado; 0-1294 (ATCC 32466) isolated from soil, Dugway, Utah; 0-3203 (Bachus WE 4465) from soil, Wisconsin. Dried specimens have been deposited in the New York Botanical Garden, Bronx, New York, in the Farlow Herbarium, Harvard University, Cambridge, Massachusetts and in the Plant Patholo Herbarium, Cornell University, Ithaca, New York, U.S.A.

Lagarde (14) also found this species on rotting wood, organic matter and insect remains in France and Spain.

Colonies on Freezing agar (9) and Oatmeal-Salts agar (23) are white, plane to somewhat floccose with gymnothecia found throughout the colony. Greater numbers of gymnothecia may sometimes be found at the periphery of the colony. No exudate, odor or coloration on the colony reverse was observed.

Somatic hyphae and elements forming the gymnothecia are more or less indistinguishable from one another and walls of both are smooth. Spirals, similar to the appendages of the gymnothecia, may be found individually or in groups on the somatic hyphae (Figure 3). These spirals are also illustrate by Lagarde (14).

Gymnothecia appear somewhat solid when packed with asci (Figures 1, 2). Spiral appendages on some gymnothecia are few.

Ascospores (Figures 3, 4) are numerous and released early by the deliquescing asci. Lagarde (14) described the ascospores of *M. racovitzae* as containing 1-4 granules, but granules were not observed in the ascospores of any of the strains.

Ascospore measurements given by Lagarde are somewhat smaller than those given here.

Lagarde (14) mentioned terminal conidia (aleuriospores), but made no mention of arthroaleuriospores.

Although it had been suggested earlier that *K. racovitzae* might be related to *Arachniotus* (19, 20), a later study of that genus (21) indicates no close relationship. Ascospores of *Arachniotus (A. candidus)* are oval to ellipsoid (21) and those of *K. racovitzae* are globose. The latter species also possesses numerous coiled appendages on the gymnothecia, but no such structures are present on the gymnothecia of *Arachniotus*.

Amauroascus aureus (3) produces gymnothecia with sinuous to spiral filaments (10). Although the ascospore of *A. aureus* are also globose, they are yellowish, ridged, possess a scalloped band and appear reticulate. Species of *Arthroderma* (1, 2, 4, 5, 7, 22, 24) and *Nannizzia* (2, 5, 24) also produce gymothecia with spiral appendages. The dumb-bell and bone-shaped segments of the gymnothecial elements of those species are lacking in *K. racovitzae*. Furthermore, ascospores of *Arthroderma* and *Nannizzia* have been determined to be yellow oblate spheroids (23).

Shanorella (4) produces yellow gymnothecia with spiral appendages; individual segments of the gymnothecia are thick-walled and tend to disarticulate. Ascospores are yellow and oblate with an equatorial band. *Apinisia* (15) produces white gymnothecia with thick-walled, disarticulating segments with spirals at the periphery; ascospores are yellowish, globose and echinulate. *Spiromastix* (8) produces brownish gymnothecia with spirals somewhat more rigid than the elements from which they arise; ascospores are oval.

Ajellomyces (16) produces buff gymnothecia with numerous coils and globose, hyaline ascospores. This fungus, however is heterothallic and is pathogenic to man and animals. Asci arise from the coils of the gymnothecia. *Emmonsiella* (11, 12, 13) also produces buff gymnothecia with numerous coils and globose, hyaline ascospores. Gymnothecia are stellate in shape rather than spherical as in *K. racovitzae*. *Emmonsiella* is also heterothallic and pathogenic to man and animals. Ascospores of *K. racovitzae* are 1.5-2 times larger than those of the two genera above.

Relationship of *K. racovitzae* with any of the genera discussed may be somewhat distant because of the numerous differences discussed.

Spirals on vegetative hyphae of strains of *Trichophyton* *mentagrophytes* are common and well known. They have also been reported in *Coccidioides immitis* under special circumstances (17, 18). Such spirals, uncommon in species of Gymnoascaceae, are frequent in *K. racovitzae.*

Young colonies and ascospores of *K. racovitzae* may be temporarily confused with young colonies and ascospores of *Arachnotheca* (3). Young colonies of both resemble one another and the spherical ascospores of both are smooth when young. Mature colonies of *Arachnotheca* are rather cottony and those of *K. racovitzae* are somewhat floccose to granular. Ascospores of the former possess an irregularly tuberculate sheath; those of the latter remain smooth.

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XYLOBOTRYUM ANDINUM, A TROPICAL PYRENOMYCETE FROM NORTHERN CALIFORNIA

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At the 1974 Stuntz Mycological Foray, *Xylobotryum andinum* Patouillard was collected near Arcata, California and is herein reported for the first time from continental North America. This unusual pyrenomycete was previously known only from the American and Asian tropics.

The genus *Xylobotryum* was erected by Patouillard in 1895 for *X. andinum* from Ecuador. The specimen from California was compared with the type specimen with which it is conspecific. In *X. andinum* the erect, branching stromata are 5-9 mm high and bear numerous lobes at the apex in which the perithecia are borne (Fig. 1). Each lobe contains one perithecium which has a distinct, separate wall (Fig. 2). Although not always visible externally, the perithecia are ostiolate with periphyses lining the canal (Fig. 3). The unitunicate asci are clavate, long-stalked, without any apical mechanism (Fig. 4). Numerous unbranched paraphyses are present at maturity. The brown, translucent spores are usually one-septate, 10-12.5 (-13) x (3-) 3.5-4.0 µm, without any germ slit or pore (Figs. 5-7). Although the well-developed, black stroma and dark spores suggest the Xylariaceae, the lack of any amyloid, apical apparatus and the lack of germ slit or pore eliminate *Xylobotryum* from that family. *Xylobotryum* keys through the Sphaeriaceae (Müller & von Arx, 1973) but its generic affinities are unknown. The undifferentiated ascus apex suggests that the asci break down within the fruiting bodies as in *Thamnomyces*. This genus also has well-developed, branched stromata but the spores are 1-celled.

Xylobotryum andinum Pat., Bull. Herb. Boiss. 3:69. 1895.

=*X. dussii* Pat. in Duss, Enum. Champ. Guadel. p. 77. 1903.

The type specimen of *Xylobotryum dussii* was examined and found to be a synonym additional to those listed by Müller and von Arx (1962).

Holotype: Ecuador, San Jorge, on decorticated wood, coll. Lagerheim, July, 1892 FH.

Distribution: *Australia* (Sydow, 1938); *China*; *Dominica* (Smith, 1901); *Ecuador*; *Guadelope*; *India* (Agnihothrudu & Barua, 1960); *Puerto Rico*; *Tasmania* (Rodway, 1926); *U.S.A., California; Trinidad.*

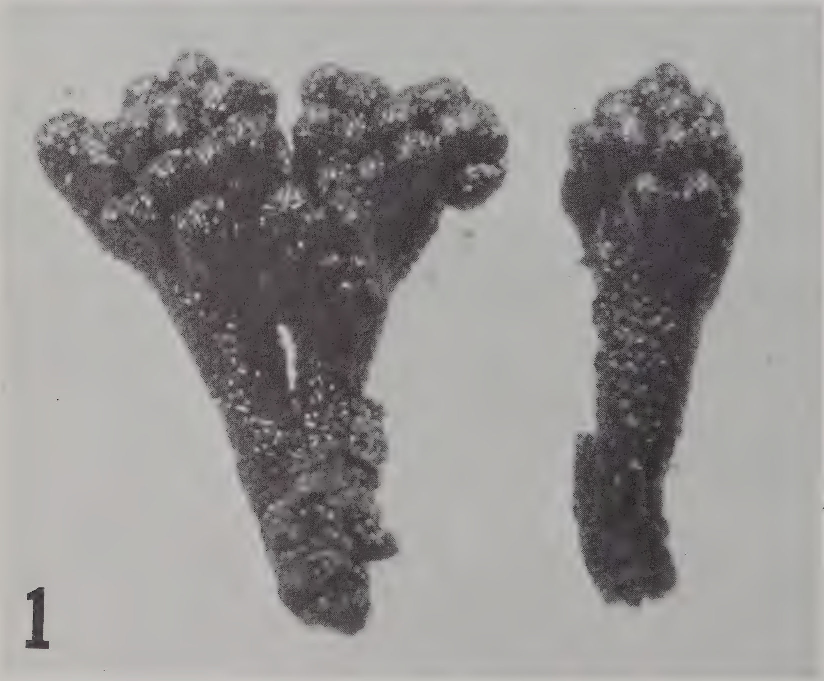
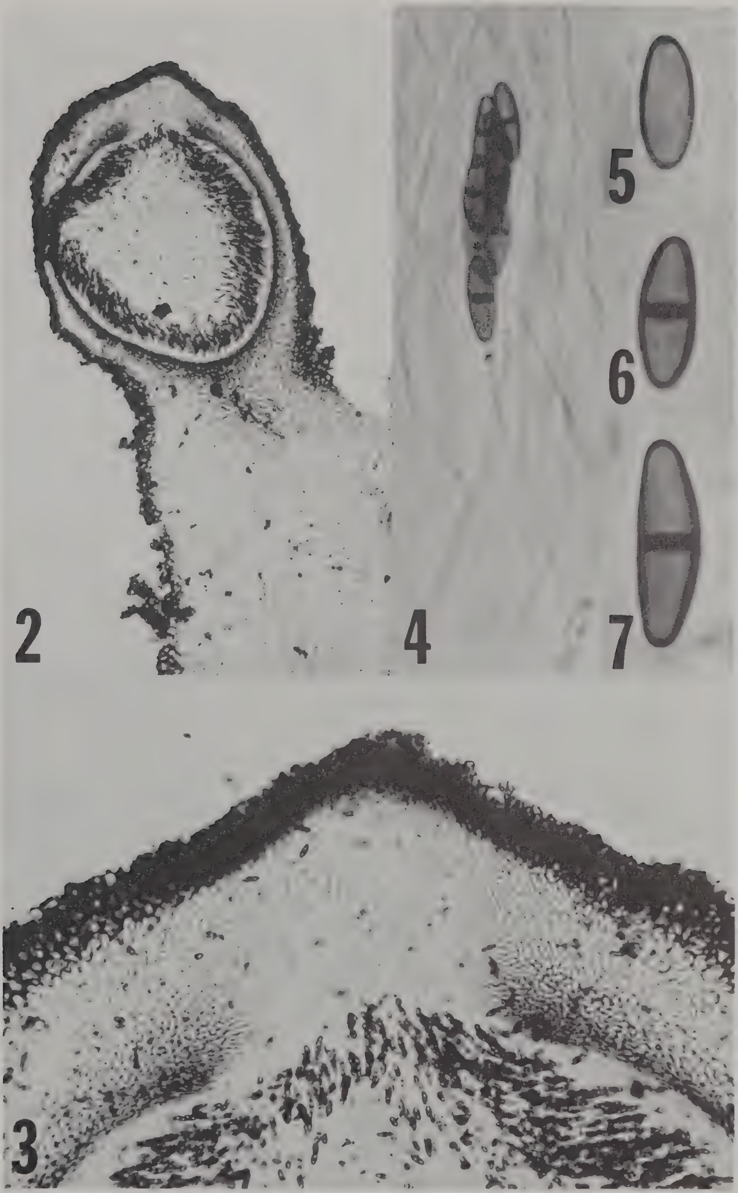


Fig. 1. *Xylobotryum andinum.* Branched and unbranched stroma.



Figs. 2-7. *Xylobotryum andinum*. 2. Section through stromatal lobe with perithecium embedded in apex x 60. 3. Section through perithecial apex x 300. 4. Ascus x 1000. 5-7. Ascospores x 2300.

Specimens Examined: China, Ting-an, Hainan, 13 Nov. 1934 coll. S.Q. Deng #6425 det. S.C. Teng CUP; Ecuador, San Jorge, July, 1892 HOLOTYPE FH; Guadeloupe, Deshaies, coll. Duss 779, 16 April 1903 HOLOTYPE of *Xylobotryum dussii* FH; Puerto Rico, Jan., 1927 coll. Müller det. J.H. Miller CUP; Trinidad, Grand Etang, coll. & det. R. Thaxter 5065, 1912-13 FH; Trinidad, La Leina Valley, Port of Spain, R. Thaxter, 1913 FH; U.S.A., California, Humboldt Co., Fern Canyon near mouth of river, on unidentified stump, coll. Mary Eckstrom, 8 Nov. 1974 OSC 35,157.

Specimens of the recognized *Xylobotryum* species were studied. Two species, *X. andinum*, the type, and *X. portentosum*, belong in the genus; *X. rickii* is excluded.

Xylobotryum portentosum (Mont.) Pat., Bull. Soc. Myc. France 16:185. 1900. (For complete synonymy, see Müller and von Arx, 1962).

X. portentosum is similar to *X. andinum*, differing primarily in the macrostructure of the stroma, which is large, up to 3 cm high and unbranched, tapering from the base to the broadly rounded apex. Perithecia form along the entire length of the stroma. Microscopically, these species are identical.

Distribution: *Brazil* (Möller, 1901); *Chile* (Montagne, 1856); *Dominica* (Smith, 1901); *Guadeloupe; Martinique.*

Specimens Examined: Guadeloupe, Capesterre, Bois du Grand-Etang, on the stipe of *Cyathea serra*, 1036 FH; Martinique, Montagne Pelee, on the stipe of *Alsophila aspera*, coll. Duss 478, 1911 FH.

Xylobotryum rickii Lloyd is excluded from this genus. The type specimen from the Lloyd Herbarium (BPI 7690) and two specimens identified by Rick were examined and found to be truly xylariaceous unlike *Xylobotryum*. The amyloid ascus apex and opaque, dark-brown spores with distinct germ slits indicate that this species is not related to *Xylobotryum portentosum* as suggested by Dennis (1970) and Müller and von Arx (1962). This species belongs in *Xylaria*.

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Sydow, H. 1938. Neue oder bemerkenswerte australische Micromyceten -- III. Ann. Mycol. 36: 297-298.

MYCOTAXON

Vol. IV, No. 1, p. 184 July-September 1976

NOTICE

ASSISTANCE REQUESTED
FOR INDEX OF DR. FRANZ PETRAK'S WORKS

The undersigned is preparing an index to the fungi and their hosts included in the mycological papers and exsiccati of Dr. Franz Petrak, and would like to know which herbaria received exsiccati and whether they are distributed or undistributed within the herbaria. He would also like to have reprints of Petrak's papers appearing in journals other than Annales Mycologici or Sydowia.

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MYCOTAXON

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SPECIFIC AND INFRASPECIFIC NAMES FOR FUNGI USED IN 1821.
IV. H - M.

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Since the preceding portion of this series appeared, no new 1821 literature has been uncovered.

Conversely, the number and obscurity of literature including fungi which appeared between 1753 and 1821 continues to be amazing. Some of it, to be sure, is important as name-bringing sources for validated names. The rest would seem at present to be more academic - local floras and enumerations of genera, etc. - but there constantly lurks the possibility that a name introduced in such a work was validated properly *after* 1821, and may replace a more popular name now in common usage, so such literature is presented along with the rest below. Because no references to these works appears in the "formulae" following this text, no abbreviations are furnished.

More pre-1821 Literature

Braune, Franz Anton von. 1797. Salzburgische flora, ober Beschreibung der in dem Ergstiste Salzburg wilwachsenden Pflanzen, nebst Angabe ihrer Wohnorte, Blühzeiten, Dauer, Gestalt ic. ihrer Unwendbarkeit in der Heilkunde und Haushaltungwissenschaft, und ihrem Nussen für Mahler, Färber, Gärber, Bienenzieher, Forster und Landwirthe. Salzburg.

Vol. 1. lxxvi + 426 + table

Vol. 2. xl + 380 + index [fungi: 249-308]

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[1] This paper represents contribution No. 475 from the Botanical Laboratories, University of Tennessee.

Browne, Patrick. 1756. The civil and natural history of Jamaica in three parts. Containing, I. An accurate description of that island, its situation and soil, with a brief account of its former and present state, government, revenues, produce and trade. II. A history of the natural productions, including the various sorts of native fossils; perfect and imperfect vegetables; quadrupedes, birds, fishes, reptiles and insects; with their properties and uses in mechanics, diet and physic. III. An account of the nature of climates in general, and their different effects upon the human body; with a detail of the diseases arising from this source, particularly within the tropics. In three dissertations. The whole illustrated with fifty copper-places: in which the most curious productions are represented of the natural size, and delineated immediately from the objects. x + map + 490 + 49 pls. + index. London.

Feldner, M. J. N. [no date] Prodromus historiae fungorum agri Vindobonensis. 775 pp. Vind[obonensae]. [Cited by Schultes, q.v., so published before 1794].

GSN: Gmelin, Jo. Frid. 1788. Caroli a Linné, Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis locis. Editio decima tertia. Vol. 1. Lipsiae.

Gorter, Davidis de. 1781. Flora Zutphanica. 88 + index. Zutphaniae.

Dörrien, Catharina Helena. 1777. Verzeichniss und Beschreibung der sämtlichen in den Fürstlich Oranien-Nassauischen Landen wildwachsenden Gewächse. vorwort + 496. Herborn.

Dörrien, Catharina Helena. 1794. Verzeichniss und Beschreibung der sämtlichen in den Fürstlich Oranien-Nassuaischen landen wilwachsenden Gewächse. vorwort + 496. Leipzig.

Haller, Alberti de. Ad enumerationem stirpium Helveticarum, emendationes et auctaria. Basel?

Pars. I. 1759. 56 pp

Pars. II. 1759. 45 pp [includes fungi]

Pars. III. ? 96 pp

Pars. IV. 1761 22 pp

Haller, Alberto v. 1769. Nomenclator ex historia plantarum indigenarum Helvetiae excerptus auctore... iv + 216. Berne.

HT: Hedwig, Ioanne. 1795. Theoria generationis et fructificationis plantarum cryptogamicarum Linnaei. xii + 268 + xlii pls. Lipsiae.

Hill, John. 1758. An account of a stone in the possession of the Right Honorable the Earl of Stafford; which on being watered produces excellent mushrooms. With the history of the Iolanthos, or violet-stone of the Germans. 38 + 2 pls. London.

Host, Nicolai Thomae. 1797. Synopsis plantarum in Austria proviciisque adiacentibus sponte crescentium. introd. + 666. Vindobonae.

Jacquin, Nicolai Josephi. 1762. Enumeratio stirpium plerarumque, quae sponte crescunt in agro Vindobonensi, montibusque confinibus. Accedunt observationum centuria et appendix de paucis exoticus. 315 + index. Vindobonae.

Leers, Joannis Danielis. 1775. Flora Herbornensis exhibens plantas circa Herbornam Nassoviorum crescentes, secundum systema sexuale Linnaeanum distributas, cum descriptionibus rariorum in primis graminum, propriisque observationibus et nomenclatore. Graminum omnium indigenorum eorumque adfinium icones CIV. Auctoris manu ad vivum delineatae aerique incisae. introd. + lix + 288 + index + xvi pls. Herbornae Nassouiorum.

Leyser, Friderici Wilhelmi. 1761. Flora Halensis exhibens plantas circa Halam Salicam crescentes secundum systema sexuale Linnaeanum distributas. v + introd. + 224 + index. Halae Salicae.

Leysser, Friderici Wilhelmi. 1783. Flora Halensis, exhibens plantas circa Halem Salicam crescentes, secundum systema sexuale Linneanum distributas. introd. + 305 + indices. Halae Salicae.

LFS: Lightfoot, John. Flora Scotica: or, a systematic arrangement, in the Linnaean method, of the native plants of Scotland and the Hebrides.

Vol. I. 1789. xli + 530.

Vol. II. 1789. pp. 531-1151 + index [includes fungi]

LSP: Linnaeus, Caroli. 1753. Species plantarum, exhibentes plantas rite cognitas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas.

Vol. II. Holmiae. pp. 561-1200 + indices.

LSpPl: Linnaeus, Caroli. Species Plantarum, exhibentes plantas rite cognitas, ad genera relatas, cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas. Editio secunda.

Vol. 1. 1762. [no fungi] 784 pp.

Vol. 2. 1763. pp. 785-1684 + index.

Ludwig, Christiani Gottlieb. 1760. Definitiones generum plantarum olim in usum auditorum collectas nunc auctas et emendatas edidit Georgius Rudolphus Boehmer. xlviii + 516 + index. Lipsiae. [Furnishes an excellent generic synonymy to pre-1753 names]

Lumnitzer, Stephani. 1791. Flora Posoniensis, exhibens plantas circa Posonium sponte crescentes, secundum systema sexuale Linneanum digestas. viii + 557 + 1 pl. Lipsiae.

Mattuschka, Henrici Godefridi. 1779. Enumeratio stirpium in Silesia sponte crescentium in usum herborisantium. introd. + 348 + index. Vratislaviae.

Moench, Conrado. 1794. Methodus plantas horti botanici et agri Marburgensis, a staminum situ describendi. 780 + index. Marburgi Cattorum.

Moench, Conradi. 1802. Supplementum ad methodum plantas a staminum situ describendi. 328 pp. Marburgi Cattorum.

PAH: Persoon, C. H. 1797. Adnotationes quaedam ad Theodori Holmskijoldi Coryphaeos Clavarias Ramariasque complectentes. pp. 120-239 [following Coryphiae]

PS: Persoon, C. H. 1801. Synopsis Methodica Fungorum. Pars prima & secunda. xxx + 706 + 5 pls. Gottingen.

PIP: Persoon, C. H. Icones pictae specierum rariorem fungorum in Synopsi Methodica descriptarum.

Fasc. I. 1803. Paris & Strasbourg. ii + 14 + pls. 1-6.

Fasc. II. 1804. Paris & Strasbourg. 15-28 + pls. 7-12.

Fasc. III. 1805. Paris & Strasbourg. 29-44 + pls. 13-18.

Fasc. IV. 1808. Paris & Strasbourg. 45-64 + pls. 19-24.

PT: Persoon, C. H. 1818. Traité sur les champignons, contenent l'indication des espèces nuisibles; précédé d'une introduction a l'histoire des champignons avec quatre planches coloriées. 10 + 276 + 2 pls. Paris.

Reichenbach, Henrico Theophilo Ludovico. 1817. Flora Lipsiensis pharmaceutica. Sistens plantarum agri Lipsiensis nunc et olim officinalium venenatarumque diagnoses, descriptiones, synonyma, locos natales, qualitates, vires et usum. xii + 248. Lipsiae.

Retzio, Andrea Jahanne. 1795. Florae Scandinaviae prodromus enumerans plantas Sueciae, Lapponiae, Finlandiae et Pomeraniae ac Daniae, Norvegiae, Holsatiae, Islandiae Groenlandiaeque. Editio altera. xvi + 383. Lipsiae.

Reyger, Gottfried. 1764. Tentamen florae Gedanensis, methodo sexuale adcommodatae.

[Vol. I] Dantisci. 293 pp.

Vol. II. Dantisci. 224 pp.

Röhling, Joh. Chr. 1796. Deutchlands flora zum bequemen Gebrauche heim Botanisiren nebst einer erklärenden Einleitung in die botanische Kunstprache zum Besten der Anfänger. Ein Taschenbuch. Bremen.

Abteilung I. lxiv + index + 384.

Abteilung II. pp. 385-540 + index [fungi: 472-540]

RAB: Roth, Alberto Gugliemlo. 1791. Vegetabilia cryptogamica minus hucusque cognita. Ann. Bot., Usteri 1: 5-12.

Schäffer, Jacob Christian. 1759. Vorläufige Beobachtungen der Schwämme um Regensburg angestellet und mit vier Kupfertafeln ausgemahlter Abbildungen erläutert. introd. + 59 + expl. plt. + IV pls. Regensburg.

Schaeffer, Jac. Chr. 1759. Isagoge in botanicam expeditiorem. vi + 96 + index + iv pls. Ratisbonae.

[Schultes, J. A.] 1794. Oestreichs flora. Ein Taschenbuch auf botanischen Excursionen. Wien.

Vol. I. introd. + 215 pp.

Vol. II. 244 pp. [fungi, pp. 192-204]

Scopoli, Joannis Antonio. 1760. Flora Carniolica exhibens plantas Carnioliae indigenas et distributas in classes naturales cum differentiis specific, synonymis recentiorum, locis natalibus, nominibus incolarum, observationibus selectis, viribus medicis. introd. + 607. Viennae.

SLT: Smith, James Edward. 1818. An account of *Rhizomorpha medullaris*, a new British fungus. Trans. Linn. Soc. London 12: 372-374.

SFH: Sprengel, Curtii. 1806. Florae Halensis tentamen novum. xvi + 420 + 13 pls. Halae Saxonum.

Wo: Weigel, Christ. Ehrenfr. 1772. Observationes Botanicae. introd. + 51 + 3 pls. Gryphiae.

J Coll: Wulfen, F. X. Plantae rariores Carinthiacae, *in* Jacquin, N. J. Collectanea ad botanicam, chemiam et historiam naturalem spectantia.

[part 1] vol. 1: 186-362. 1786.

[part 2] vol. 2: 112-234. 1788.

[continued as WJ 1 and WJ 2]

For reasons unexplainable, in part III of this series, all names beginning with G, adopted by Fries (Systema Mycologicum), were overlooked and not included. It is, of course, necessary to list them.

G (only those names adopted by Fries)

galeatus (Cantharellus) Fr: 324 ← [Sae: 371 (Merulius)]
galericulatus (Agaricus) Fr: 143 ← [Scop: 455]
gallicus (Polyporus, as "P. Fav. gallicus") Fr: 345, nom. nov.
galopus (Agaricus) Fr: 143 ← [PS: 379 ← POM 2: 56]
gambosus (Agaricus) Fr: 50, sp. nov.
gausapatus (Agaricus) Fr: 43, sp. nov.
gelatinosum (Hydnum) Fr: 407 ← [Scop: 472]
gentilis (Agaricus) Fr: 212, nom. nov.
geophyllus (Agaricus) Fr: 340 ← [BH: 546, pl. 522, fig. 2, as "geophilus"]
gibbosa (Daedalea) Fr: 338 ← [POM 1: 21 (Merulius)]
gibbus (Agaricus) Fr: 81 ← [PS: 449]
gigantea (Thelephora) Fr: 448 ← [FO 1: 152]
giganteus (Agaricus) Fr: 80 ← [SEF: pl. 244 + accom. text ← Sib: 420]
giganteus (Polyporus) Fr: 356 ← [PS: 521 (Boletus)]
gilvus (Agaricus) Fr: 80 ← [PS: 448]
glabrata (Thelephora) Fr: 438 ← ["Vetensk. Acad. Handl. 1820: 51"]
glabrum (Geoglossum) Fr: 488, not 483 ← [PRNB: 116]
glandulosus (Agaricus) Fr: 182 ← [BH: 388, pl. 426]
glaucopus (Agaricus) Fr: 224 ← [Sch 4: 23]
glojocephalus (Agaricus) Fr: 278 ← [DC 6: 52, as "gloiocephalus"]
glossoides (Clavaria) Fr: 487 † ← [PAH: 200]
glutinosum (Geoglossum) Fr: 489 ← [POM 1: 11]
glutinosus (Agaricus) Fr: 315 ← [Sch 4: 17]
glyciosmus (Agaricus) Fr: 72, not 92 ← [FO 2: 194]
gossypinus (Agaricus) Fr: 310 ← [BH: 419, pl. 425, fig. 2]
gracilis (Agaricus) Fr: 299 † ← [PS: 425]
gracilis (Clavaria) Fr: 475 ← [PAH: 182]
graminicola (Agaricus) Fr: 261 ← [NS: 202, as Agaricus Mycena ______ †]
grammopodius (Agaricus) Fr: 93 ← [BH: 617, pl. 548]
granulatus (Boletus) Fr: 387 ← [LSP: 1177]
granulosa (Thelephora) Fr: 446 ← [PS: 576]
granulosus (Agaricus) Fr: 24 ← [BEF: 79]
graveolens (Agaricus) Fr: 45 ← [PS: 361]

grisea (Clavaria) Fr: 468 ← [PCC: 44]
griseocyaneus (Agaricus: "griseo-cyaneus" of index) Fr: 202, nom. nov.
griseo-fuscus (Agaricus) Fr: 29 ← [DC 6: 52]
gunneri (Agaricus) Fr: 285, nom. nov.

-- H --

haematochelis (Agaricus) M: 82, N&B: 312 ← [BH: 660, pl. 527, fig. 1, as "aimatochelis"]
haematopus (Agaricus) Fr: 149 ← [POM 2: 56]
haematospermus (Agaricus) Fr: 282, M: 86 ← [BH: 638, pl. 595, fig. 1, as "aimatospermus"]
haemispherica (Peziza) G: 665 ← [PS: 647, as "hemispherica"]
hariolorum (Agaricus) Fr: 125, M: 74, N&B: 315 ← [BH: 618, pl. 585, fig. II, pl. 56]
haustellaris (Agaricus) Fr: 274 ← [FO 2: 232]
hebepodius (Agaricus) Fr: 97, sp. nov.
hederae (Astoma) G: 525 ← [SEF: pl. 371, fig. 5 (Sphaeria)]
hederae (Hypoderma xylomoides var.) M: 152, var. nov.
hederae (Sclerotium) Schl: 59, sp. nov.
hederaecola (Sphaeria lichenoides var.) M: 146, var. nov.
helveolus (Agaricus) M: 84-85, SA: 585 ← [BH: 653, pl. 431, fig. V]
helveolus (Agaricus araneosus var.) SA: 583, M: 82 ← [BH: pl. 431, fig. V only as
"A. aran. helveolus"]
helvola (Clavaria) Fr: 482 ← [PAH: 201 as "helveola"]
helvola (Lepiota) G: 603 ← [BH: 653, pl. 431, fig. 1 (Agaricus "helveolus")]
helvus (Agaricus) Fr: 72, sp. nov.
hemispherica (Tremella) Schl: 60, sp. nov.
hemitrichus (Agaricus) Fr: 280 ← [PS: 296]
hepatica (Fistulina) Fr: 396, not 16, G: 648 ← [PS: 549 (Boletus) ← Sch 4: 82 (Boletus)]
hepatica (Thelephora) Fr: 439, nom. nov.
hepaticus (Boletus) M: 39, L: 470, H: 26, P: 444, HFL: pl. 126 + text ← [Sch 4: 82]
heraclearia (Sphaeria punctiformis var.) M: 146, var. nov.; Fr 2: 525
heraclei (Erysiphe) SA: 615, Schl: 57, M: 133 ← ["Schleich. Crypt. Exs. no. 89"]
heraclei (Xyloma) Schl: 60, sp. nov.
herbariorum (Eurotium) G: 566-567 ← [WH: 111 (Mucor)]
herbariorum (Mucor) M: 114 ← [WH: 111]

herbarum (Byssus) M: 12-13 ← [PAB: 32 (Dematium)]
herbarum (Calycina) G: 670 ← [PAB: 30 (Peziza)]
herbarum (Cladosporium) G: 556, LD 20: 496-497 ← [PAB: 32 (Dematium)]
herbarum (Clavaria) M: 32-33 ← [PRNB: 118]
herbarum (Dematium) Schl: 57, N&B: 368 ← [PAB: 32]
herbarum (Exormatostoma) G: 522 ← [PS: 78 (Sphaeria)]
herbarum (Geoglossum) G: 659 ← [PRNB: 118 (Clavaria)]
herbarum (Peziza) Schl: 58 ← [PAB: 30]
herbarum (Sphaeria) N&B: 300, Schl: 59, H: 7 ← [PS: 78]
herbarum (Torula) G: 557 ← [LM 3: 21 (Torula) ← PS: 693 (Monilia)]
herbarum (Xyloma) Schl: 60, M: 150 † ← [A&S: 65]
herculeana (Clavaria) P: 270, G: 657 ← [LFS: 1065]
heteroclitus (Boletus) G: 640, P: 244-245 ← [Bolt: 164]
heteroclitus (Polyporus) Fr: 344 ← [Bolt: 164 (Boletus)]
heteromorpha (Daedalea) Fr: 340 ← [FO 1: 108]
heyderi (Mitrula) G: 660, sp. nov.
hiascens (Agaricus) Fr: 303, sp. nov.
hilaris (Agaricus) Fr: 254, nom. nov.
himantioides (Merulius) Fr: 329 ← [FO 2: 238]
hinnuleus (Agaricus) P: 215, H: 21-22 ← [With 4: 232]
hippopinus (Agaricus) P: 209-210 ← [With 4: 202]
hippotrichoides (Thamnomyces) Ehren: 519 ← [SEF: pl. 200 + text, (Sphaeria "hypotrichoides"]
hippotrichoides (Rhizomorpha setiformis var. Lichen ___) M:136-137† ← [Wild.:360(Lichen ___)]
hirneolus (Agaricus) Fr: 206 ← [FO 2: 211]
hirsuta (Agaricus ephemeroides var.) M: 55 ← [BH: 403, pl. 582?]
hirsuta (Sphaeria) H: 7, G: 527 ← [PAB: 24]
hirsuta (Thelephora) Fr: 439, Schl: 60, N&B: 342, HFD: 13, pl. 1738, fig. 1 ← [Willd: 397]
hirsutum (Geoglossum) Fr: 488, G: 658, H: 30, LD 18: 358 ← [PAH: 169]
hirsutum (Helotium) LD 20: 509-510 ← [TM 1: 23]
hirsutum (Stereum) G: 653 ← [Willd: 397 ("Thaelaephora")]
hirsutus (Polyporus) Fr: 367 ← [JColl 2: 149 (Boletus)]
hirtipes (Agaricus) Fr: 206, not 269, HFD: 12, pl. 1730, fig. 2 ← [Sae: 272]
hirtus (Polyporus) Fr: 345, nom. nov.
hispida (Peziza) P: 462 ← [HFA: 635]
hispida (Sphaeria) M: 144 ← [TM 2: 17]
hispidulum (Chordostylum) LD 21: 166 ← [TM 1: 39]

hispidulus (Agaricus) Fr: 201 ← [FO 2: 97, not BEF: 81]
hispidus (Boletus) M: 42, SA: 548, G: 640, N&B: 337 ← [BH: 351, pl. 210, 493]
hispidus (Polyporus) Fr: 362 ← [BH: 351, pls. 210, 493 (Boletus)]
hollii (Hydnum) Fr: 420 ← ["Schmidt: 87" (Sistotrema)]
hordus (Agaricus) Fr: 47, sp. nov.
horisontalis (Agaricus) SA: 582 ← [BH: 573, pl. 324, as "horizontalis"]
horizontalis (Agaricus) M: 80, H: 21, P: 211 † ← [BH: 573, pl. 324]
hornemannii (Agaricus) Fr: 285, not 47, nom. nov.
hortensis (Agaricus) Fr: 195 ← [PS: 362]
hudsonii (Agaricus) M: 64 ← [PS: 390]
hudsoni (Mycena) G: 620 ← [PS: 390 (Agaricus)]
humuli (Erysiphe) M: 133 ← [DC 6: 106]
hyalina (Octospora) G: 667 ← [PS: 655 (Peziza)]
hyalina (Sphaeria) Schl: 59 ← ["P[ersoon?]"]
hybrida (Clavaria) Re: 54 ← [BH: 194, pl. 440, fig. 1]
hybrida (Helvella) P: 453 ← [SEF: pl. 238 + text]
hybrida (Morchella) G: 662 ← [SEF: pl. 238 + text (Helvella)]
hybrida (Peziza) G: 666 ← [SEF: pl. 369, fig. 1 + text]
hybridum (Hydnum) M: 38 ← [BH: 307, pl. 453, fig. 2]
hybridus (Agaricus) Fr: 239, SA: 584 ← [BH: index, pl. 398 only †]
hybridus ([Agaricus]) M: 83 ← [BH: index, pl. 398 only†]
hybridus (Polyporus) Fr: 362 † ← [Bosc: 84 (Boletus)]
hydnoidea (Thelephora) Fr: 445 ← [POM 1: 15 (Corticium)]
hydnoides (Ceratium) M: 13, G: 562 ← [LM 3: 20]
hydnoides (Peziza) P: 467 ← [SEF: pl. 178 + text]
hydrogrammus (Agaricus) Fr: 197, M: 66 ← [BH: 515, pl. 564, figs. A, B, G, H]
hydrolips (Merulius var. Helvella ____) M: 48 † ← [BH: 292, pl. 465, fig. 2 (Helvella ____)]
hydrolips (Merulius) N&B: 333, M: 48 ← [BH: 292, pl. 465, fig. 2 (Helvella)]
hydrophilus (Agaricus) M: 83 ← [BH: 440, pl. 511]
hydrophora (Mucor) G: 561 ← [PS: 202, not TM 2: 5]
hydrophora (Peziza) M: 27 ← [BH: 243, pl. 410, fig. 2]
hydrophora (Sphaeria peziza var. Peziza ____) M: 143-144 † ← [BH: 243 (Peziza ____)]
hydrophorus (Agaricus) Fr: 304, M: 57 ← [BH: 411, pl. 558, fig. 2]
hypnorum (Agaricus) N&B: 317 ← [PS: 385, as "hypnorum" ← BEFC 1: 117, as "hypni"]
hypnorum (Agaricus mycena) Z: 106 † ← [BEFC 1: 117 (Agaricus "hypni")]
hypnorum (Agaricus) Fr: 267 ← [BEFC 1: 117, as "hypni" ?Schrank]

hypodermia (Peziza) M: 19-20 ← [DC 6: 19]
hypophylla (Sphaeria) Spr: 318 ← ["Rebentisch"]
hypothejus (Agaricus) Fr: 35, nom. nov.
hypotrichoides (Sphaeria) Schl: 59 ← [?SEF: pl. 200 + text]
hypoxylon (Sphaeria) H: 4 ← [POM 1: 20]
hypoxylon (Hypoxylon cornutum var. Sphaeria ____)M: 137-138 † ← [POM 1: 20 (Sphaeria)]
hypoxylon (Sphaeria [Cordyceps]) FSS: no. 181 ← [LSP: 1182 (Clavaria)]
hypoxylon (Sphaeria) P: 496 ← [LSP: 1182 (Clavaria)]
hypoxylon (Sphaeria) Schl: 59 ← [POM 1: 20]
hysginus (Agaricus) Fr: 67 ← [FO 2: 192]
hysterioides (Xyloma) Schl: 60, P: 283 ← [PIC: 38, pl. 10, fig. 3]
hystrix (Hydnum) Fr: 410 ← [BEF: 113, "hystricinum"]
hystrix (Sphaeria) Schl: 59 ← [TM 2: 53]

-- I --

icterinus (Agaricus) Fr: 207, sp. nov.
igniarius (Boletus) M: 41, P: 447, G: 641, H: 28 ← [LSpPl: 1645 ← LSP: 1176]
igniarius (Polyporus) Fr: 375, not 378 ← [LSP: 1176 (Boletus)]
ileopodius (Agaricus) M: 81 ← [BH: 656, pl. 578, 592, 586, fig. 2]
ilicinum (Erineum) Re: 56, M: 17, ← [LDC: 15]
ilicinus (Agaricus) Fr: 251, not 257 ← [DC 6: 48]
ilicium (Erineum) SA: 529 ← [LDC: 15, as "ilicinum"]
iliopodius (Agaricus) Fr: 231 ← [BH: 656, as "ileopodius"]
illinitus (Agaricus) Fr: 23 ← [FO 2: 8]
imberbis (Boletus) M: 40 ← [BH: 339, pl. 445 fig. 1]
imberbis (Peziza) SA: 532-533, M: 22-23 ← [BH: 245, pl. 467, fig. 2]
imbricata (Daedalea) P: 251-252 ← [BH: 349, pl. 366 (Boletus)]
imbricatum (Hydnum) Fr: 398, M: 38, G: 650 ← [LSpPl: 1647 ← LSP: 1178]
imbricatus (Agaricus) Fr: 42 ← [FO 1: 27]
imbricatus (Boletus) M: 42, P: 252 ← [BH: 349, pl. 366]
imbricatus (Polyporus) Fr: 357 ← [BH: 349, pl. 366 (Boletus)]
immersa (Nemania) G: 517 ← [SEF: pl. 374, fig. 1 + text (Sphaeria)]
immersa (Patellaria) G: 664 ← [SEF: pl. 369, fig. 9 + text (Peziza), not SEF: 389]
immersum (Sclerotium) SA: 617 ← [DC 6: 111 (Sclerotium)]

impatiens (Agaricus) Fr :302, not 244, sp. nov.
impressa (Sphaeria) FSS: no. 152, sp. nov., Fr 2: 564
inaequalis (Clavaria) Fr: 481 ← [FD 14: 8, pl. 836]
inamoenus (Agaricus) Fr: 111 ← [FO 1: 10]
incana (Omphalia amethystea [var.]) G: 615 ← [BH: pl. 570, fig. 1]
incanus (Agaricus) Fr: 209, sp. nov.
incarnatus (Hypochnus) Schl: 58, sp. nov.
incarnatus (Polyporus) Fr: 379 ← [PS: 546 (Boletus) ← PAB: 30 (Poria)]
incomtus (Agaricus) Fr: 171 ← [FO 2: 212, not 218]
inconstans (Agaricus) Fr: 181, SA: 560, M: 51 ← [PCS: 17]
inconstans (Pleuropus) G: 615 ← [PCS: 17 (Agaricus)]
incrassata (Rivularia) P: 178 ← [SEF 14: no. 967? (Ulva) as alga]
incurvus (Agaricus) Re: 52-53 ← [Sch 4: 29]
infractus (Agaricus) Fr: 223 ← [PS: 283 ← POM 2: 42, as "infrcactus"]
inequale (Peripherostoma fuscum [var.]) G: 514, var. nov.
inflexa (Peziza) P: 458 ← [Bolt: 71, as "inflecta"]
infundibuliformis (Agaricus) SA: 574, M: 67, N&B: 328, P: 393[1] ← [BH: 510, pls. 286, 553]
infundibuliformis (Agaricus) P: 393[1] ← [Bolt: 34]
infundibuliformis (Boletus melanopus var.) M: 43 ← [PIPR: 8, pl. 4 (Boletus ____)]
infundibuliformis (Helotium) G: 661 ← [Sch 4: 110 (Helvella)]
infundibuliformis (Hymenoscyphus) G: 673 ← [BEFC 1: 211 (Peziza "infundibulum"), non Sch]
infundibuliformis (Merulius) H: 25 ← [Bolt: 34 (Agaricus)]
infundibuliformis (Peziza crocea var.) M: 25, var. nov.?
infundibulum (Hydnum) Fr: 401 ← [Swartz, "Vetensk. Acad. Handl. 1810: 244"]
infundibulum (Polyporus melanopus var.) Fr: 347 ← [PD: 70 (Boletus "infundibuliformis"]
ingratus (Agaricus) Fr: 123 ← [Sae: 304]
inodorus (Agaricus) M: 79-80 ← [BH: 552, pl. 524, fig. 2]
inopus (Agaricus) Fr: 251 ← [FO 2: 32]
inornatus (Agaricus) Fr: 93 ← [SEF: pl. 342 + text]
inquilans (Agaricus) Fr: 264 ← [FO 2: 170]
inquinans (Dermodium) G: 570 ← [LM 3: 25, as "Demordium"]
inquinans (Octospora) G: 667, sp. nov. ← [non PS: 631 (Peziza) ← Sch: t. 158 (Peziza)]
inquinans (Peziza) Schl: 58, H: 32 ← [PS: 631]
inquinans (Sphaeria) M: 145 ← [PS: 83]
insidens (Sphaeria) G: 528 ← [SEF: pl. 372, fig. 12, + text]
insitiva (Sphaeria) M: 140 ← [TM 2: 36]
insulsus (Agaricus) Fr: 68, sp. nov.

integer (Agaricus) P: 403, Schl: 56, H: 20 ← [LSP: 1171]
integrella (Mycena) G: 621 ← [PIC: 54, pl. 14 (Agaricus)]
integrellus (Agaricus) Fr: 161 ← [PIC: 54, pl. 14]
integrellus (Agaricus mycena) Z: 104 † ← [PIC: 54, pl. 14 (Agaricus ____)]
intertexta (Byssus) M: 12 ← [DC2: 68]
intestina (Rhizomorpha) M: 136 ← [DC 6: 115]
intumescens (Gyraria) G: 593 ← [SEF 26: no. 1870 (Tremella), as alga)]
intumescens (Tremella) H: 32 ← [SEF 26: no. 1870, as alga]
intybacea (Thelephora) Fr: 431 ← [PS: 567]
inundatum (Myrothecium) G: 569 ← [TM 1: 25]
involuta (Omphalia) G: 611 ← [BEFC 1: 39 (Agaricus)]
involutus (Agaricus) Fr: 271, not 270 ← [BEFC 1: 39]
ionides (Agaricus) M: 73-74 ← [BH: 557, pl. 533, fig. 3]
irregulare (Peripherostoma) G: 514 ← [SEF: pl. 374, fig. 9 + text (Sphaeria)]
irregularis (Sphaeria) P: 286 ← [SEF: pl. 374, fig. 9 + text]
irrigatus (Agaricus) Fr: 101 ← [PS: 361]
isabellinus (Hypochnus) LD 22: 368, Schl: 58 ← [FO 2: 281]
iungenda (Aspergillus) MNA: 510 ← ["Ehrenberg. Flora 3"]

-- J --

janthinus (Agaricus purus var.) M: 72, var. nov.
jecorinus (Agaricus) Fr: 66, sp. nov.
jolithus (Dematium) Schl: 57 ← [WFL: 535]
jonides (Agaricus) Fr: 107 ← [BH: 557, pl. 533, fig. 3, as "ionides"]
jubatus (Agaricus) Fr: 196, sp. nov.
jugis (Agaricus) Fr: 177, nom. nov.
juglandis (Boletus) M: 43, SA: 552, N&B: 337, R: 25 ← [Sch 4: 75, "iuglandis"]
juglandis (Erineum) M: 17 ← ["Schleich. Cent. Exs. no. 92"]
juglandis (Erineum) Schl: 57, sp. nov.?
juglandis (Stilbospora) FSS: no. 215, sp. nov., Fr 3: 485
juncea (Clavaria) Fr: 479 ← [FO 2: 291]
junceus (Agaricus) Fr: 208, sp. nov.
juncicola (Agaricus) Fr: 160, sp. nov.

juniperi (Tremella) Schl: 60 ← [LSP: 1157, as alga, as "juniperina"]
juniperina (Gyraria) G: 594 ← [LSP: 1157, as alga (Tremella)]
juniperina (Tremella) LD 20: 140 ← [LSP: 1157, as alga]
junonius (Agaricus) Fr: 244, sp. nov.
junonius (Agaricus) SB: no. 582, pl. 582, fig. 1 ← [Fr: 244]

-- K --

katui (Boletus) Spr: 310 ← [EHor: 93]
kirbii (Sphaeria) G: 529 ← [SEF: pl. 371, fig. 3 + text]
kunzei (Clavaria) Fr: 474, sp. nov.
küttlingerii (Thelephora, "küllingerii" of index) Fr: 434 ← ["Mart. Erl.: 396"]

-- L --

labellum (Peziza) M: 25-26, N&B: 349 ← [BH: 262, pl. 204]
laburni (Sphaeria) P: 280-281, M: 142 ← [POM 1: 68]
labyrinthiformis (Agaricus) SA: 558-559 ← [BH: 377, pl. 352, 442, fig. 1]
labyrinthiformis (Boletus) M: 41, SA: 551 ← [BH: 357, pl. 497, fig. 1]
laccatus (Agaricus) Fr: 106 ← [Scop: 444]
lacerus (Agaricus) Fr: 257, sp. nov.
laciniata (Clavaria) M: 33, SA: 541, P: 473 ← [Sch 4: 122]
laciniata (Thelephora) Fr: 431 ← [POM 1: 36 (Corticium)]
laciniatum (Stereum) G: 652 ← [POM 1: 36 (Corticium)]
laciniatus (Boletus) P: 251 †, in obs.
lacrimans (Merulius, "lacrymans" of index) Fr: 328 ← [WJ 2: 111 (Boletus)]
lacrymabundus (Agaricus) Fr: 287, H: 23-24, P: 425, M: 55, SA: 566 ← [BH: 438, pl. 194, 525, fig. 3]
lacrymalis (Agaricus) P: 218-219 ← [BEF: 75, as "lacrimalis"]
lacrymalis (Gyraria) G: 595 ← [PS: 628 (Tremella)]
lacrymans (Boletus) P: 245-246 ← [WJ 2: 111]
lacrymans (Merulius) H: 25-26, SA: 557, M: 49 ← [WJ 2: 111 (Boletus)]
lactea (Peziza) M: 23, SA: 533 ← [BH: 253, pl. 376, fig. 3]

lactea (Thelephora) Fr: 452, nom. nov.
lactea (Typhoderma) G: 559 ← ["Dillwyn. Conf.: 79" (Conferva)]
lacteum (Hydnum) Fr: 412 ← [FO 2: 266 (Sistotrema)]
lacteus (Agaricus) Fr: 152 ← [PS: 394]
lacteus (Agaricus mycena) Z: 106 † ← [PS: 394 (Agaricus _____)]
lacteus (Polyporus) Fr: 359, sp. nov.
lactifluum (Leccinum) G: 647 ← [With 4: 320 (Boletus)]
lactifluus (Agaricus) P: 193, R: 31, H: 20 ← [LSP: 1172]
lacunosum (Sclerotium) G: 591 ← [PD: 15] Fr 2: 252 (as var.).
lacustris (Peziza) FSS: no. 173, sp. nov., Fr 2: 143
laetus (Agaricus) Fr: 102 ← [POM 2: 48]
laevigatum (Hydnum) Fr: 399 ← [Swartz, "Vetensk. Acad. Handl. 1810: 243"]
laevigatus (Agaricus metatus var.) Fr: 144 ← [PS: 380 (Agaricus _____)]
laevis (Nemania) G: 519 ← [SEF: pl. 394, fig. 5 + text (Sphaeria)]
laevis (Thelephora) Fr: 451 ← [PD: 30 (Corticium)]
lagopus (Agaricus) Fr: 312, sp. nov.
lamellirugis (Agaricus) Fr: 184 ← [DC 6: 44]
lamprocephalus (Agaricus) M: 83 ← [BH: 652, pl. 544, fig. 2]
lampropus (Agaricus) Fr: 203 ← [FO 1: 19]
lanata (Cytispora) FSS: no. 159, sp. nov.: Fr 2: 482
lanatus (Agaricus) P: 211 ← [SEF: pl. 417 + text]
laneus (Aspergillus) G: 555 ← [LM 3: 16 ← "Ditmar Icon."]
lanuginosa (Peziza) M: 25, N&B: 349, P: 462 ← [BH: 260, pl. 396, fig. 2]
lanuginosus (Agaricus) Fr: 257, M: 83, N&B: 312, P: 212-213 —— [BH: 659, pl. 370]
laricis (Boletus) R: 18 ← [?"Linn."]
laricis (Boletus) Schl: 56, sp. nov.?
lascivus (Agaricus) Fr: 110, sp. nov.
lata (Nemania) G: 518 ← [POM 1: 66 (Sphaeria)]
lata (Sphaeria) Schl: 59, H: 6 ← [POM 1: 66]
lateralis (Agaricus) P: 238-239 ← [Bolt: 71]
lateralis (Boletus) H: 27 ← [Bolt: 83]
latericola (Boletus) H: 27 ← [Bolt: 83]
lateritia (Auricularia cariophyllea var.) M: 33, var. nov.
lateritia (Himantia) LD 21: 166 ← [PS: 704 †]
lateritia (Peziza vesciculosa var.) M: 25 ← [BH: 270, pl. 457, figs. 1G, I, R]
lateritia (Pratella) G: 627 ← [Sch 4: 22 (Agaricus)]

lateritius (Agaricus) Fr: 265, nom. nov.
lateritius (Agaricus) Fr: 288 ← [PC: 19, non Sch 4: 22]
lateritius (Agaricus pratella) Z: 313 † ← [Sch 4: 22 (Agaricus _____)]
latissima (Daedalea) Fr: 340 ← [FO 1: 128 (Polyporus)]
latus (Agaricus) Fr: 215 ← [PS: 276]
lauri (Astoma) G: 525 † ← [SEF: pl. 371 + text (Sphaeria)]
lauri (Clavaria) Fr: 486 ← [Brot: 475]
lauri (Xyloma) Schl: 60, sp. nov.?
lecanora (Peziza) Schl: 58 ← ["Schm. & K"]
lejocephalus (Agaricus) Fr: 277 ← [DC 6: 53, as "leïocephalus"]
lenticulans (Peziza) Schl: 58 ← [POM 2: 85]
lenticularis (Octospora) G: 667, sp. nov., non POM 2: 85 ← BH: 248.
lenticularis (Peziza) M: 20-21, SA: 530 ← [BH: 248, pl. 300, figs. a, c]
lentus (Agaricus) Fr: 253 ← [PS: 287]
leoninum (Hydnum) Fr: 411, sp. nov.
leoninus (Agaricus) Fr: 199 ← [Sch 4: 21]
lepideus (Agaricus) Fr : 176 ← [FO 1: 21]
lepista (Agaricus) Fr: 271, not 265, sp. nov.
leporina (Scodellina) G: 668 ← [BEF: 117 (Peziza)]
leptocephala (Coltricia) G: 645 ← [WJ 1: 142 (Boletus)]
leptocephalus (Polyporus) Fr: 349 ← [WJ 1: 142 (Boletus)]
leucocephalus (Agaricus) R: 37, SA: 580, M: 77 ← [BH: 597, pl. 428, fig. 1, pl. 536]
leucocreas (Xyloma) Schl: 60: M: 149, G: 545 ← [LDC: 63]
leucoloma (Octospora) G: 667 ← [PS: 665 (Peziza) ← "Hedwig. Musc.: 13"]
leucomela (Peziza) L: 467 ← [DC 6: 21 ← PS: 670]
leucophaea (Helvella) G: 662, LD 20: 512 ← [PS: 616 ← "Batav. Fung. armen.: 25"]
leucopodium (Leccinum aurantiacum [var.]) G: 646, var. nov.
leucopodius (Agaricus) M: 80 ← [BH: 556, pl. 533, fig. 2]
leucopus (Agaricus) Fr: 236 ← [BH: 556, pl. 533, fig. 2, as "leucopodius"]
leucosperma (Cytispora) FSS: no. 156 ← [POM 1: 81 (Naemaspora)] Fr 2: 543
leucosperma (Nemaspora) SA: 524, M: 148, Spr: 278, LD 22: 386 ← [PS: 108 —— POM 1: 81,
in obs.]
leucostoma (Sphaeria) M: 142 ← [PAB: 23]
leucostomum (Engizostoma) G: 520 ← [PAB: 23 (Sphaeria)]
leviuscula (Gemmularia) LD 18: 311 ← ["Rafinesque. J. Phys., Aug. 1819"]
lichenoides (Periconia) M: 18 ← [TM 2: 2]

lichenoides (Sphaeria) L: 486, M: 146 ← [DC 2: 299]
lichenoides (Xyloma) SA: 519 ← [DC 2: 304 †]
ligatus (Agaricus) Fr: 32, sp. nov.
ligatus (Agaricus) P: 414, sp. nov.?
lignatilis (Agaricus) Fr: 94 † ← [PS: 368][2]
lignatilis (Agaricus) SA: 577, M: 71 ← [BH: 528, pl. 554, fig. 1]
lignatilis (Agaricus gymnopus) Z: 93 † ← [PS: 368 (Agaricus _____)]
ligni (Sphaeria byssiseda var.) M: 144, var. nov.
lignifraga (Botrytis) SA: 527, M: 14 ← [BH: 103, pl. 504, fig. 6 (Mucor)]
lignifragus (Mucor) P: 503 † ← [BH: 103, pl. 504, fig. 6]
lignisedum (Hysterium ostraceum var.) M: 153, var. nov.
ligula (Clavaria) Fr: 477 ← [Sch 4: 116]
limacinus (Agaricus) P: 209 ← [Sch 4: 74]
limacinus (Gymnopus) G: 609 ← [Sch 4: 74 (Agaricus)]
limonius (Agaricus) Fr: 213 ← [FO 2: 56]
linearis (Peziza scutellata var.) P: 263-264 †, var. nov.
lineatus (Agaricus) Fr: 152, M: 63 ← [BH: 547, pl. 522, fig. 3]
linkii (Agaricus) Fr: 204 ← [FO 2: 217]
listeri (Agaricus) P: 191 ← [With 4: 158, p. p.]
littoralis (Conferva) Fodere: 249 ← ?
livida (Thelephora) Fr: 447 ← [FO 2: 276 ← POM 1: 58 (Corticium)]
livida (Vaginata) G: 601, sp. nov, non PS: 247 (Amanita)
livida (Tremella mesenteriformis var.) M: 28-29 ← [BH: 230, pl. 406, 499, fig. 6]
livido-fuscus (Agaricus stipitus var.) P: 198, var. nov.
livido-rubescens (Agaricus lactifluus) Z: 317 † ← [BEFC 2: 51]
lividus (Agaricus) M: 77, SA: 580 ← [BH: pl. 382 only †]
lividus (Agaricus russula) Z: 354 † ← [BH: pl. 382 only (Agaricus _____) †]
lividus (Boletus) Fr: 389 ← [BH: 327, pl. 490, fig. 2]
lividus (Boletus chrysenteron var.) M: 45-46 ← [BH: 327, pl. 490, fig. 2 (Boletus _____)]
lobata (Corniola) G: 637 ← [PS: 494 (Merulius)]
lobata (Omphalia) G: 612 ← [SEF: pl. 186 + text (Agaricus)]
lobatus (Cantharellus) Fr: 323 ← [PS: 494 (Merulius)]
longa (Sphaeria) G: 529 ← [SEF: pl. 393, fig. 4 + text]
longicaudus (Agaricus) Fr: 248 ← [PS: 332]
longipes (Agaricus) SA: 578, M: 75 ← [BH: 613, pl. 232, 515]

longum (Hysterium) LD 22: 401 ← [PS: 99]
lonicera (Erysiphe) SA: 615 ← [DC 6: 107, as "lonicerae"]
lonicerae (Erysiphe) M: 133 ← [DC 6: 107]
lonicerae (Sphaeria) G: 528 ← [SEF: pl. 393, fig. 6 + text]
lonicerae (Xyloma) Schl: 60, sp. nov.?
lubrica (Leotia) Schl: 58, G: 660 ← [Scop: 477 (Elvela)]
lubricus (Agaricus) Fr: 252 ← [PS: 307]
lucida (Grifola) G: 644 ← [GSN: 1434 (Boletus) ← "Leysser. Fl. Hols."]
lucidus (Agaricus) Fr: 235 ← [PS: 299]
lucidus (Boletus) H: 27, P: 439-440 ← [GSN: 1434 ← "Leysser. Fl. Hols."]
lucidus (Polyporus) Fr: 353 ← [GSN: 1434 (Boletus) ← "Leysser. Fl. Hols."]
lucifugus (Agaricus) Fr: 258 ← [FO 2: 50]
lugubris (Agaricus) Fr: 254, sp. nov.
lurida (Octospora) G: 668 ← [PS: 666 (Peziza)]
luridum (Leccinum) G: 648 ← [Sch 4: 78 (Boletus)]
luridus (Agaricus) Fr: 65 † ← [PS: 436, non Sch.][3]
luridus (Agaricus) Fr: 40 † ← [Sch 4: 30][3]
luridus (Agaricus gymnopus) Z: 98 † ← [Sch 4: 30 (Agaricus _____)]
luridus (Boletus) Fr: 391, K: 25 - 26 ← [Sch 4: 78]
luridus (Gymnopus) G: 606 ← [Sch 4: 30 (Agaricus)]
luridus (Lactarius) G: 625 ← [PS: 436 (Agaricus) non Sch]
luscinus (Agaricus) Fr: 87 ← [FO 2: 108]
lutea (Auricularia reflexa var.) M: 34 ← [BH: 281, pl. 274]
lutea (Clavaria) M: 31, L: 468 ← [LFF: 126]
lutea (Clavaria coralloides var.) M: 32 ← [BH: 201]
lutea (Clavaria lutea var.) M: 31 ← [LFF: 126 (Clavaria _____)]
lutea (Peziza fructigena var.) M: 23 ← [BH: 236]
lutea (Peziza vesciculosa var.) M: 25 ← [BH: 270]
lutea (Peziza stercoraria var.) M: 22 ← [BH: 256, pl. 376]
lutea (Peziza stercoraria [var.]) SA: 532 ← [BH: 256, pl. 376]
lutea (Russula) G: 618 ← [HFA: 611 (Agaricus)]
lutea (Tremella cerebrina var.) M: 28 ← [BH: 221]
lutea (Tremella mesenteriformis var.) M: 28-29 ← (BH: 230, pl. 406]
luteo-alba (Mycena) G: 620 ← [Bolt: 38, as "lateo albus" (Agaricus)]
luteoalbus (Agaricus) Fr: 152 ← [Bolt: 38, as "lateo albus"]

luteo-albus (Agaricus stipitis var.) P: 199, var. nov.
luteolus (Agaricus pyxidatus var.) M: 68 ← [BH: 514]
luteo-virens (Agaricus), "luteovirens" of index, Fr: 41 ← ["Pers." ← A&S: 168]
lutescens (Boletus) N&B: 339 ← [PAB: 29]
lutescens (Cantharellus) Fr: 320, G: 636 ← [PS: 489 (Merulius)]
lutescens (Merulius) SA: 556, M: 47 ← [PS: 489]
luteus (Agaricus) P: 212, H: 22 ← [Bolt: 50][4]
luteus (Agaricus) Fr: 55 ← [HFA: 611][4]
luteus (Agaricus caespitosus var.) M: 84 ← [Bolt: 50 (Agaricus ______)]
luteus (Agaricus russula) Z: 352 † ← [HFA: 611 (Agaricus ______)]
"luetus" (Boletus: orthographic error for luteus?) H: 27 ← [LSP: 1177]
luteus (Boletus hispidus var.) M: 42 ← [BH: 351, pl. 493]
luteus (Boletus hispidus [var.]) SA: 548 ← [BH: 351, pl. 493]
luteus (Suillus) G: 646 ← [Sch 4: 81 (Boletus) ← Scop: 465 (Boletus)]
lycoperdioides (Piligena) HFD: 13, t. 1740, fig. 2 ← [Sae: 221]
lycoperdoides (Agaricus) N&B: 314 ← [BH: 610, pl. 516, fig. 1, as "lycoperdonoides"]
lycoperdoides (Agaricus gymnopus) Z: 92 † ← [BH: 610, pl. 516, fig. 1, as Agaricus "lycoperdonoides"]
lycoperdoides (Asterophora) G: 635 ← [BH: 610, pl. 516, fig. 1 (Agaricus "lycoperdonoides")]
lycoperdoides (Merulius) M: 47 ← [BH: 610, pl. 516, fig. 1 (Agaricus "lycoperdonoides")]
lycoperdoides (Sphaeria) P: 486 ← [WO: 47]

-- M --

macer (Agaricus) P: 217 ← [With 4: 256]
macilentus (Agaricus) Fr: 131, sp. nov.
macrodon (Hydnum) Fr: 415 ← [PS: 560]
macropus (Agaricus) Fr: 215 ← [PS: 275]
macropus (Clavaria) Fr: 475 ← [PAH: 183]
macropus (Macroscyphus) G: 672 ← [POM 1: 26 ← Bolt: pl. 96 (no name)]
macrorhiza (Clavaria) Fr: 478 ← [Swartz, "Vetensk. Acad. Handl. 1811: 135"]
macrosperma (Stilbospora) M: 147 ← [PD: 14, as "macrospora"]
maculaeformis (Sphaeria) M: 145 ← [PD: 52]
maculaeformis (Thelephora) Fr: 454 ← [FO 1: 150]

maculare (Hysterium) FSS: no. 167, sp. nov.: Fr 2: 592
maculata (Nemania) G: 517 ← [TM 2: 33, as "macula" (Sphaeria)]
maculatus (Agaricus) Fr: 45 ← [A&S: 186]
maculatus (Agaricus muscarius var.) P: 200-201 ← [Sch 4: 39 (Agaricus ______)]
maculiformis (Sphaeria) Schl: 59 ← [PD: 52, as "maculaeformis"]
maculosus (Agaricus) Fr: 253 ← [PS: 288]
majalis (Agaricus) Fr: 205 ← [FO 2: 172]
malachius (Agaricus) Fr: 218 ← [FO 2: 71]
mali (Hypoderma xylomoides var.) M: 152, var. nov.?
mammaeformis (Sphaeria) M: 143 ← [HV: 13, as "mammiformis" ← Dick 1: 24, as "mammosa"]
mammillanum (Xylaria polymorpha [var.]) G: 513, var. nov.
mammosa (Sphaeria) P: 486 ← [Dick 1: 24]
mammosus (Agaricus) P: 219 ← [LSP: 1174]
mappalis (Amanita citrina [var.]) G: 599 ← [Willd: 381 (Agaricus "mappa" BEF: 57]
marcida (Leotia) G: 660 ← [PS: 613 ← FD 11: 3, pl. 654, fig. 1 (Phallus)]
marginatus (Polyporus) Fr: 372 ← [PD: 28 (Boletus)]
marginellus (Agaricus) Fr: 113 ← [PS: 309]
marzuolus (Agaricus) Fr: 84, sp. nov.
mastoideus (Agaricus) Fr: 20, sp. nov.
mastrucatus (Agaricus) Fr: 190 ← [FO 2: 229]
maurus (Agaricus) Fr: 168, sp. nov.
maxima (Daedalea) Fr: 332 ← [Brot: 468 (Boletus)]
meculiformis (Sphaeria) N&B: 300 ← [PD: 52, as "maculaeformis"]
medicaginis (Rhizoctonia) M: 135, SA: 616 ← [DC 6: 111]
medius (Agaricus) Fr: 278 ← [Sae: 248]
medulla panis (Boletus) P: 247 †, Schl: 56, M: 40, N&B: 340 —— [WJ 1: 141]
medulla panis (Polyporus) Fr: 380 † ← [WJ 1: 141 (Boletus)]
medullaria (Poria) G: 640, nom. nov.
medullaris (Daedalea) P: 250, nom. nov.
medullaris (Rhizomorpha) P: 307 ← [SLT 12: 374]
melaena (Sphaeria) FSS: no. 200, sp. nov.: Fr 2: 431.
melaleuca (Hypoderma) LD 22: 370, nom. nov.
melaleucum (Hydnum) Fr: 406 ← [FO 1: 142 ← "Swartz"]
melaleucum (Hysterium) Schl: 58 ← [FO 1: 192]
melaleucus (Agaricus) Fr: 114 ← [PS: 355]
melanopus (Boletus melanopus var.) M: 43 ← [PIC: 9 (Boletus _____)]

melanopus (Polyporus) Fr: index only, not 347 (nom. nud.) ← [PS: 517 (Boletus
infundibuliformis [var.] ← PIC: 9 (Boletus _____)]
melanospermus (Agaricus) Fr: 283, M: 60, N&B: 323 ← [BH: 628, pl. 540, fig. 2]
melanospermus (Agaricus pratella) Z: 310 † ← [BH: 628, pl. 540, fig. 2]
melasperma (Cytispora) FSS: no. 157, sp. nov.: Fr 2: 545.
melastoma (Calycina) G: 670 ← [SEF: pl. 149, + text (Peziza)]
meleagris (Gymnopus) G: 609 ← [SEF: pl. 171 + text (Agaricus)]
melinoides (Agaricus) Fr: 206, M: 63-64 ← [BH: 444, pl. 560, fig. 1]
melinoides (Agaricus mycena) Z: 104 † ← [BH: 444, pl. 560, fig. 1 (Agaricus _____)]
melizius (Agaricus) Fr: 13, sp. nov.?
melleus (Agaricus) Fr: 30 ← [FD 17: 9, pl. 1013]
melogramma (Peripherostoma) G: 514 ← [BH: 182, pl. 492, fig. 1 (Variolaria)]
melogramma (Sphaeria) N&B: 297, SA: 521-522, M: 140 ← [BH: 182, pl. 492, fig. 1
(Variolaria)]
melogramma (Sphaeria rugosa var.) P: 289-290 ← [BH: 182, pl. 492, fig. 1 (Variolaria _____)]
membranacea (Coniophora) M: 36 ← [DC 6: 34]
membranaceum (Hydnum) Fr: 415, P: 451, SA: 545, M: 37, L: 469 ← [BH: 302, pl. 481, fig. 1]
membranaceus (Boletus) Ehren: 519 ← ?
membranaceus (Merulius) P: 180-181 ← [With 4: 153 (Merulius) ← Bolt: 177 (Helvella)]
membranaceus (Polyporus) Fr: 370 ← [SIN: 1922 (Boletus)]
merdarius (Agaricus) Fr: 291, sp. nov.
merismoides (Phlebia) Fr: 427, not 417 ← [FO 2: 235 (Merulius)]
mesenterica (Gyraria) G: 593 ← [WJ 1: 142 (Tremella "mesenteriformis")][5]
mesenterica (Thelephora) Schl: 60 ← [Bolt: 172 (Helvella)]
mesenterica (Tremella) LD 20: 179, P: 509, H: 32 ← [Sch 4: 108 (Elvela)][5]
mesentericum (Stereum) G: 653 ← [Bolt: 172 (Helvella)]
mesenteriformis (Tremella) M: 28-29, SA: 526-527 ← [WJ 1: 142][5]
mesomorphus (Agaricus) Fr: 23, M: 85-86, N&B: 309 ← [BH: 481, pl. 506, fig. 1]
mesplinum (Erineum) M: 16 ← [DC 6: 12 †]
metachrous (Agaricus) Fr: 172, not 144, nom. nov.
metatus (Agaricus) Fr: index only, not 144 †, nom. nud.
mezerei (Sphaeria) Schl: 59, sp. nov.?
micaceus (Agaricus) M: 56, N&B: 318, SA: 567 ← [BH: 415, pls. 94, 246, 565]
micaceus (Agaricus, as "A. copr. micaceus") Fr: 309 ← [BH: 415, pls. 94, 246, 565]
micans (Clavaria) SA: 538, M: 30 ← [PAH: 217]
micans (Pistillaria) Fr: 297 ← [PAH: 217 (Clavaria)]

micans (Polyporus) Fr: 383 ← [Ehren: 30 (Poria)]
michelii (Polyporus) Fr: 343, sp. nov.
microdon (Hydnum) Fr: 417 ← [PS: 561]
microporus (Polyporus) Fr: 376 ← [SIN: 1925 (Boletus)]
microsperma (Cytispora) FSS: no. 158, sp. nov., Fr 2: 546
microsperma (Stilbospora) M: 147-148 ← [POM 1: 31]
microstoma (Sphaeria) FSS: no. 185 ← [PS: 40] Fr 2: 388
microstomum (Engizostoma) G: 520 ← [PS: 40 (Sphaeria)]
militare (Hypoxylon) M: 137 ← [LSP: 1182 (Clavaria)]
militaris (Sphaeria) L: 485, P: 276-278, SA: 519 ← [LSP: 1182 (Clavaria)]
militaris (Xylaria) G: 510-511 ← [LSP: 1182 (Clavaria)]
millus (Agaricus) Fr: 93 ← [SEF: pl. 184 + text]
miniata (Clavaria) P: 267-268, sp. nov.
miniata (Sphaeria peziza var.) M: 143-144, var. nov.?
miniatus (Agaricus) Fr: 105, nom. nov.
minima (Hydrophora) LD 22: 261 ← [TM 2: 5]
minor (Amanita muscaria [var.])G: 600, var. nov.
minor (Xyloma multivalve var.) M: 150, var. nov.
minus (Helmisporium) LD 20: 496, nom. nov.?
minuta (Mitrula) Fr: 492 ← [SEF: pl. 391 + text (Clavaria)]
minuta (Tremella) Schl: 60, sp. nov.?
minutula (Peziza) P: 457, sp. nov.?
minutulus (Agaricus) P: 410 ← [Sch 4: 72]
minutum (Geoglossum) G: 659 ← [SEF: pl. 391 + text (Clavaria)]
minutum (Hydnum) Fr: 412 ← [Sae: 394]
mitis (Agaricus) Fr: 188 ← [POM 1: 54]
mitissimus (Agaricus) Fr: 69, sp. nov.
mitrata (Geoglossum) H: 30 ← [Dick 4: 27 (Clavaria)]
mitra (Helvella) P: 255-256, Fodere: 249, L: 468, SA: 537, LD 20: 510, M: 29, H: 31 ← [LSP: 1180]
molibdocephalus (Agaricus) SA: 578, M: 73 ← [BH: 620, pl. 523]
mollis (Agaricus) Fr: 274, not 184, SA: 574, M: 68, P: 433 ← [Sch 4: 49]
mollis (Crepidopus) G: 616 ← [Sch 4: 49 (Agaricus)]
mollis (Polyporus) Fr: 360, not 364 ← [POM 1: 22 (Boletus)]
mollis (Thelephora) Fr: 443, sp. nov.

mollissima (Thelephora) Fr: 435 ← [PS: 572 †]
molluscus (Merulius) Fr: 329, sp. nov.
molluscus (Polyporus) Fr: 384 ← [PS: 547 (Boletus)]
molybdinus (Agaricus) Fr: 49 ← [BH: 620, pl. 523, as "molibdocephalus"]
momentaneus (Agaricus ephemerus var.) M: 57, var. nov. ← [BH: index, pl. 128 only †]
monilioides (Acrosporium) G: 552 ← [NS "Ueberblick": 14]
monilioides (Epochnium) G: 550 ← [LM 3: 18]
monilioides (Isaria) M: 13 ← [A&S: 362]
monocella (Helvella) LD 20: 512 ← [Sch 4: 106, as "monacella"]
montanus (Agaricus) Fr: 293 ← [POM 1: 9]
mori (Polyporus) Fr: 344 ← ["Pollini. Pl. Nov.: 35" (Boletus)]
mori (Sphaeria) P: 279-280 ← [RelS 2: 31]
moriforme (Astoma) G: 524 ← [TM 2: 22 (Sphaeria)]
moriformis (Arthonia) Spr: 279 ← ["Ach[arius]" (Dothidea)]
moriformis (Sphaeria) H: 8, Schl: 59 ← [TM 2: 22]
moschatum (Tuber) G: 592, SA: 619, ← [BH: 79]
mouceron (Agaricus) P: 192, SA: 576 ← [BH: 580, pl. 142]
mucedo (Mucor) H: 13, L: 481, M: 114, SA: 601, P: 501-502, N&B: 357 ← [LSP: 1185]
mucerdae (Mitrula) Fr: 492 ← [Sae: 405 (Clavaria)]
mucida (Clavaria) Fr: 476, Schl: 56 ← [PAH: 187]
mucidum (Hydnum) Fr: 418, not 416 ← [GSN 2: 1440]
mucidus (Agaricus) Fr: 28 ← [Schr: 116]
mucidus (Boletus) N&B: 340 ← [SFH: 377]
mucidus (Polyporus) Fr: 382 ← [PS: 546 (Boletus) ← POM 1: 87 (Poria)]
mucor (Agaricus) Fr: 155, not 156 ← [BEFC 1: 91]
mucosus (Agaricus) SA: 584, M: 83 ← [BH: 661, pl. 596, fig. 2]
mucronata (Aregma) Schl: 56 ← [FO 1: 225 ← PD: 38 (Puccinia)]
multicapsulare (Peripherostoma concentricum [var.]) G: 513 ← [SEF: pl. 436 + text
(Sphaeria "multicapsula")]
multiceps (Peripherostoma) G: 514 ← [SEF: pl. 394, fig. 8 + text (Sphaeria)]
multiceps (Sphaeria) P: 494 ← [SEF: pl. 394, fig. 8 + text]
multicolor (Agaricus) Fr: 48 ← [PS: 350]
multivalve (Phacidium) Schl: 58 ← ["K."]
multivalve (Xyloma) G: 546, SA: 518, M: 150 ← [DC 2: 303]
muralis (Agaricus) Fr: 165 ← [SEF: pl. 322 + text]
murcidus (Agaricus) Fr: 299, sp. nov.

muricatus (Agaricus) Fr: 244, sp. nov.
murinaceus (Agaricus) Fr: 116, not 110, M: 77 ← [BH: 588, pl. 520]
murinus (Agaricus) Fr: 115 ← [BEF: 79]
murinus (Mucor) G: 561 ← [PS: 201] Fr 3: 315 (Hydrophora)
muscaria (Agaricus pseudo-aurantiacus var. Amanita ____) M: 87-88 ← [LSP: 1172
    (Agaricus ____)]
muscaria (Amanita) H: 19, G: 600, R: 41 ← [LSP: 1172 (Agaricus)]
muscarius (Agaricus) Fr: 16, P: 200-201, L: 476, N&B: 307, SA: 587-588 ← [LSP: 1172]
muscicola (Pistillaria) Fr: 498, not 298 ← [POM 2: 60 (Clavaria)]
muscigena (Auricularia) M: 34, not sp. nov. ← [PS: 572 (Thelephora)]
muscigena (Corniola) G: 637 ← [BH: index, pl. 288 only (Agaricus)]
muscigena (Thelephora) L: 469 ← [PS: 572]
muscigenus (Agaricus) Fr: 145 ← [Sae: 307]
muscigenus (Agaricus) P: 238 ← [BH: index, pl. 288 only †]
muscigenus (Cantharellus) Fr: 323 ← [BH: index, pl. 288 only (Agaricus) †]
muscigenus (Merulius) SA: 557, M: 48 ← [BH: index, pl. 288 only (Agaricus) †]
muscoidea (Peziza) Re: 49, sp. nov.[6]
muscoides (Clavaria) M: 32, L: 468, N&B: 345, SA: 540, P: 475, H: 30 ← [LSP: 1183]
muscorum (Agaricus) Fr: 167 ← ["Hoffm[ann]"]
muscorum (Canthare-lus) Fr: 325 ← [RAB 1: 10 (Merulius)]
muscorum (Hydnum) Schl: 57, sp. nov.?
muscorum (Rhizoctonia) FSS: no. 174, sp. nov., Fr 2: 265
muscorum (Sclerotium) G: 591 ← [PS: 120] Fr 2: 252
muscorum (Tremella) Schl: 60, sp. nov.?
mutabilis (Agaricus) Fr: 245, not 244 ← [Sch 4: 6 ← Scop: 440]
mutabilis (Boletus aureus [var.]) SA: 553, var. nov.
mutabilis (Tubercularia) Schl: 60, sp. nov.?
mutilus (Agaricus) Fr: 191, sp. nov.
mycenoides (Agaricus) Fr: 246, sp. nov.
myomyces (Agaricus) Fr: 44, ← [PD: 20]
myomyces (HFD 29: 11, t. 1729 ← [Fr: 44]
myomyces (Agaricus gymnopus) Z: 98 † ← [PD: 20 (Agaricus ____)]
myomyces (Gymnopus) G: 608 ← [PD: 20 (Agaricus)]
myosotis (Agaricus) Fr: 290 ← [FO 2: 34]
myosurus (Agaricus) Fr: 132 ← [FO 2: 129]

myrtilli (Hypoderma virgultorum var.) M: 152, var. nov.?
mythilinum (Hysterium) LD 22: 402, sp. nov.?
mytilinum (Hysterium) Spr: 278, G: 510 ← [PS: 97]

Notes

1. It would appear that BH and Bolt originated independent concepts of *Agaricus infundibuliformis*. Bolt is near presentday *Cantharellus infundibuliformis*, while BH seems to be a *Clitocybe*, *s. l.* Validation by M is synonymous to *Craterellus cornucopioides* of Persoon. Validation by P leads to both Bolt and BH!

2. Fries states PS: 368 as protologue, but with "sed descri. erronea." Does this constitute validation since Fries obviously had another organism in mind?

3. Fr: 65 and Fr: 40 are homonyms but not synonyms. Nomenclaturally, either name can be used, but not both.

4. The concepts of Bolt and HFA are apparently different.

5. Sch and WJ 1 are two different roots, but both wind up near *Tremella*, with validation by G and orthographic error in addition.

6. Stated by Re as "Balbis in epist." By modern standards, the authority citation would read "[Balbis] apud Re."

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ADDITIONS TO THE HYPOGEOUS MYCOFLORA OF COLORADO. I. ASCOMYCETES.

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SUMMARY

The following hypogeous Ascomycetes are reported for Colorado, U.S.A.: *Elaphomyces granulatus* var. *asperulus*, *E. reticulatus*, *E. subviscidus*, *Geopora cooperi* f. *cooperi* and f. *gilkeyae*, *Hydnotrya cerebriformis*, *H. michaelis*, and *H. variiformis*. Six of these taxa represent new records for Colorado.

Mycological investigations in Colorado, Wyoming, and Idaho have produced few records of hypogeous Ascomycetes. Hawker (1968a) listed six from Idaho: *Elaphomyces granulatus* var. *asperulus* (Vitt.) Hawker, *Barssia oregonensis* Gilkey, *Hydnotrya cerebriformis* Harkn., *Geopora cooperi* Harkn. f. *cooperi*, *Choiromyces alveolatus* (Harkn.) Trappe (≡ *Piersonia alveolata* Harkn.), and *Tuber californicum* Harkn. Burdsall (1968) reported *Geopora cooperi* f. *cooperi* and f. *gilkeyae* from Idaho. Only two taxa have been cited from Colorado. *Elaphomyces granulatus* var. *asperulus* was recorded from Custer County (Cockerell 1889, Dodge 1929), but we could not locate the collection for verification. *Geopora cooperi* f. *gilkeyae* was collected in Clear Creek County (Burdsall 1968, Cooke 1968).

Marr (1967) describes four climax regions on the east slope of the Front Range in Boulder County: lower montane, upper montane, subalpine, and alpine tundra. Many of the fungi listed below were collected in Boulder County during 1969, 1970, 1973, and 1975. Since most, if not all, hypogeous Ascomycetes are presumed to form ectomycorrhizae, we paid special attention to host trees associated with sporocarps.

All specimens were rehydrated for microscopic examination in 5% KOH. Rehydration by heating sections in cotton blue-lactic acid was particularly useful for locating spores with well developed ornamentation in immature specimens of Tuberales. Collections are deposited in herbaria of Oregon State University (OSC), San Francisco State University (SFSC), University of Michigan (MICH), and the New York Botanical Garden (NY).

1. *ELAPHOMYCES GRANULATUS* Fr. var. *ASPERULUS* (Vitt.) Hawker *sensu* M. Lange, Trans. Brit. Mycol. Soc. 50(1): 135. 1967.

COLLECTIONS EXAMINED: BOULDER CO.--Mitchell Lake, west of Ward, Fogel F311, F312 (OSC). GRAND CO.--Frazer Experimental Forest, Fogel F244 (OSC).

Hypogeous in mineral soil among ectomycorrhizae of *Picea engelmannii* Parry and *Pinus contorta* Dougl., June to August, elev. 2,900 to 3,300 m. The Mitchell Lake site has a mixed stand of *P. engelmannii* and *Abies lasiocarpa* (Hook.) Nutt. with a *Vaccinium* ground cover. The Frazer site is an open stand of *P. contorta* with sparse ground cover.

The taxonomic problems of differentiating *E. granulatus* Fr. var. *granulatus* from var. *asperulus*, as discussed at length by Lange (1956), Hawker *et al* (1967), Hawker (1968b), and Arteman (1968), cannot be resolved until the type collections are found or the taxa are neotypified. Neotypification should be based on specimens from continental Europe, but no European mycologist has chosen to take this essential step. Meanwhile, our experience with many collections of these taxa from western North America leads us to follow Lange's and Arteman's conclusion: specimens having spores ornamented with minute, crowded spines less than 1 µm long that coalesce in patches should be designated *E. asperulus* Vitt. At the same time, we agree with Hawker *et al* (1967) that *E. asperulus* is so closely related to *E. granulatus* that the former is best reduced to a variety of the latter.

2. *ELAPHOMYCES RETICULATUS* Vitt. *sensu* M. Lange, Dansk Bot. Ark. 16: 23. 1956.

COLLECTION EXAMINED: BOULDER CO.--Flagstaff Mt. near Boulder, Fogel F1106 (OSC).

Hypogeous in mineral soil among pine ectomycorrhizae in a *Pinus ponderosa* Laws. stand with a scattered understory of small *Pseudotsuga menziesii* (Mirb.) Franco, May 25, 1975, elev. 2,135 m.

We have followed Lange's (1956) concept of this species, which apparently still needs neotypification.

3. *ELAPHOMYCES SUBVISCIDUS* (Zeller) Trappe & Guzmán, Madrõno 21: 128-129. 1971. (published in 1972).

COLLECTION EXAMINED: BOULDER CO.--Flagstaff Mt. near Boulder, Fogel F203 (OSC).

Hypogeous among pine ectomycorrhizae in a *Pinus ponderosa* stand with a scattered understory of *Pseudotsuga menziesii*, June 3, 1970, elev. 2,135 m.

Because this is the first report of the species since the type was described from southwestern Oregon by Zeller (1947), the redescription of the type by Trappe and Guzmán (1972) can be further expanded by incorporation of our data:

ASCOCARPS subglobose, up to 30 x 50 mm., smooth, not subviscid, white to dull light gray, drying light yellow to brownish orange, encrusted with soil held together by abundant light yellow hyphae and hyphal tufts emerging from the surface. PERIDIUM 2.5-3.0 mm thick, with a thin, pale yellow outer layer and a thick, white to light gray inner layer. GLEBA dark brown before maturity, nearly black at maturity, a powdery mass of spores and hyphae. ODOR of onions.

SPORES globose, (12-) 17-27 (-29) µm including ornamentation, light olive to light brown when immature, dark reddish brown at maturity, in cotton blue-lactic acid dark blue in youth but nonreactive at maturity, monoguttulate. Ornamentation of crowded spines 1-2 x 0.2 µm, separated by 0.2 to 0.5 µm or often joined in two's and three's by ridges but never forming a partial reticulum, embedded in a gelatinous matrix, often separating from the spore surface when cover slip is tapped.

ASCI globose, hyaline, thin-walled, 38-50 µm diam.

GLEBAL HYPHAE hyaline to pale yellowish brown, 1.5-4 (-6) µm diam, with occasional swellings and short lateral branches, apices obtuse; brown amorphous deposits frequent between hyphae in cotton blue-lactic acid.

PERIDIAL HYPHAE: Emergent, superficial hyphae sinuous, hyaline, thin-walled, 2.5-4.0 µm diam. Outer peridial layer 100-150 µm thick, of periclinal, single to fascicled hyphae 3-5 µm thick with hyaline to pale yellow, thin to slightly thickened walls. Inner layer of interwoven fascicles of a few to many, hyaline to pale yellow hyphae 4-8 µm diam. with refractive thickening of the walls to 1-3 µm.

No distinctive reaction to Melzer's reagent.

Cross sections of the dried peridia of the Colorado specimens show large gray, lens-shaped areas separated by fine, white lines. This is an artifact of drying and not differentiated tissue in the sense of that found in *E. reticulatus* and related species which have marbled peridia.

4. *GEOPORA COOPERI* Harkn. f. *COOPERI*, Bull. Calif. Acad. Sci. 1: 168. 1885.

COLLECTIONS EXAMINED: BOULDER CO.--West of Gold Hill, Fogel F350 (OSC). GILPIN CO.--Rollinsville, Thiers 11470 (SFSC).

Hypogeous among ectomycorrhizae of *Pinus contorta*, June to August, elev. 2,800 m. The Gold Hill site is a windswept ridgetop with shallow, stony soil that supports an open stand of *P. contorta* and *Pseudotsuga menziesii*.

Litter accumulates only under tree crowns or around clumps of trees, with the intervening ground resembling a desert pavement.

5. *GEOPORA COOPERI* Harkn. f. *GILKEYAE* Burdsall, Mycologia 60: 518-519. 1968.

COLLECTIONS EXAMINED: BOULDER CO.--Rainbow Lakes, near Nederland, Fogel F279 (OSC); Gross Reservoir, southwest of Boulder, Fogel F224 (OSC). CLEAR CREEK CO.--Echo Lake, south of Idaho Springs, Fogel F670 (OSC), Trappe 3698 (OSC), Rogerson 4003 (NY). SAN MIGUEL CO.--Trout Lake, Smith 32974 (OSC, MICH).

Hypogeous among ectomycorrhizae of *Pinus contorta* and *Picea engelmannii*, June to September, elev. 2,250 to 3,250 m. Gross Reservoir is a dry site with litter mats only under *P. contorta* crowns and with the intervening bare, loose, sandy soil. Rainbow Lakes, Echo Lake, and Trout Lake are high elevation sites with continuous litter layers under dense stands of *Picea engelmannii* and *Abies lasiocarpa*.

6. *HYDNOTRYA CEREBRIFORMIS* Harkn., Proc. Calif. Acad. Sci. Ser. 3. 1: 266. 1899.

COLLECTION EXAMINED: LARIMER CO.--Zimmerman Lake, near Cameron Pass, Trappe 3680 (OSC).

Hypogeous in rotten wood among ectomycorrhizae of *Abies lasiocarpa* in a mixed stand of *A. lasiocarpa* and *Picea engelmannii*, Sept. 5, 1973, elev. 3,170 m.

7. *HYDNOTRYA MICHAELIS* (Fischer) Trappe, Mycotaxon 2(1): 113. 1975.

COLLECTIONS EXAMINED: BOULDER CO.--Lake Eldora, near Nederland, Fogel F301 (OSC). CLEAR CREEK CO.--Mt. Goliath Natural Area, Trappe 3691 (OSC).

Hypogeous among ectomycorrhizae of *Pinus contorta* at Lake Eldora and in a *Picea engelmannii* - *Pinus aristata* Engelm. krummholz at Mt. Goliath, Sept., elev. 2,800 to 3,400 m.

8. *HYDNOTRYA VARIIFORMIS* Gilkey, Mycologia 39: 444. 1947.

COLLECTIONS EXAMINED: BOULDER CO.--Fourth of July Campground, near Nederland, Thiers (SFSC). WYOMING, CARBON CO.--Medicine Bow Mountains, just north of the Colorado-Wyoming border, leg. Binegar, Cooke 28610 (Gilkey 466, OSC).

Hypogeous under *Pinus*, Aug., elev. ±3,200 m.

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COMPARATIVE ZONE ELECTROPHORESIS AND MATING EXPERIMENTS IN THE TAXONOMY OF MUCOR HIEMALIS

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SUMMARY

Crude protein extracts from mycelium of 31 isolates of *Mucor hiemalis* and related species were subjected to acrylamide gel electrophoresis. Gels were stained for α-Esterase, Alcohol dehydrogenase, Malic dehydrogenase, Lactic dehydrogenase, Benzaldehyde oxidase, and Tetrazolium oxidase. Using a single linkage cluster analysis, the isolates were grouped on the basis of their isozyme similarities. In addition, mating tests were performed, and the patterns of sexual interactions observed. Isozyme similarity and sexual compatibility shows a correlation of .61. This is discussed in relationship to the taxonomy of the section *Hiemalis* of the genus *Mucor*. Caution is advised in the use ot comparative isozyme studies in fungal taxonomy.

INTRODUCTION

Comparative gel electrophoresis of soluble proteins has been used with varying success as a criterion for species delimitation in fungi. This has recently been done by Moorhouse and de Bertoldi (1975) and Bradford, Jones and Garber (1975). Most studies show that isozyme patterns for isolates of a single species are more similar than patterns for isolates of different species (for example: Hall, 1969; Clare, Flentje, and Atkinson, 1968; and Shechter, 1973).

However, some investigators have found so much intraspecific variation in isozyme patterns that they have recommended against the use of electrophoresis in taxonomic studies (Glynn and Reid, 1969, and Peberdy and Turner, 1968). In particular, Stout and Shaw (1974) found as much variation between seven isolates of *Mucor racemosus* (identified on morphological grounds) as they found between isolates representing twenty different *Mucor* species.

For three isolates of *M. circinelloides*, they found no isozyme similarities. Moreover, they found no isozyme differences between *M. hiemalis* and *M. mucedo*, species which are distinct morphologically.

There are two ways to interpret these conflicts between morphological and isozyme data. The first possibility is that comparative zone electrophoresis is of limited usefulness in defining taxa. If this is true, more classical, usually morphological, tests should continue to be used in taxonomic studies of fungi. If, on the other hand, isozyme comparison is a good indication of genetic similarity, and if it is desirable that taxonomic similarity correlate with genetic similarity, then in cases where electrophoretic and morphological determinations of taxa conflict, the biochemical methods should be considered more valid.

To decide between these two alternatives, a third means of distinguishing species should be employed. The classical test (Mayr, 1966) for deciding whether individuals are members of the same species is to test their ability to mate with one another, or if a direct mating is impossible, whether they will mate with a third individual. By comparing results of matings with data from electrophoretic and morphological studies, a decision about the validity of each of the diagnostic methods can be reached. Most previous isozyme studies have been done with morphologically dissimilar species, which presumably do not mate with each other. Such studies have shown that electrophoretic and morphological data agree. A real test of electrophoresis as a taxonomic tool would be accomplished by studying closely related species, in which morphological differences are ill-defined, and with which mating experiments are possible.

The section *Hiemalis* of the genus *Mucor* provides an interesting group of organisms for a study of this type. Since successful matings only occur within the same species, that is, interspecific hybridization does not occur, mating experiments are useful in delimiting species in this genus (Schipper, 1969). This method works extremely well in deciding relationships of even closely related species. It has provided the basis for a recent reorganization of much of the section *Hiemalis* (Schipper, 1973). Within the *Mucor hiemalis* complex of species, "there is no correlation between successful matings and morphological characteristics"

TABLE I

ISOLATES STUDIED

Mucor hiemalis Wehmer:
ATCC 8977a(+), ATCC 8977b(-), UNB 5(+), UNB R107-4(25)-4(+)(albino mutant of UNB 5), UNB 6(-), F 461(+), F 466(+), F 477(+), F 511(+), F 520(+), F 525(+), F 526(+), F 546(+), F 547(+), F 429(-), F 434(-), F 447(-), F 517(-), F 541(-)

M. hiemalis f. hiemalis:
CBS 200.28(-), CBS 201.28(+)

M. hiemalis f. hiemalis (= *M. humicolus* Raillo):
CBS 224.29(+)

M. hiemalis f. hiemalis (= *M. adventitius* Zycha):
CBS 229.35(+)

M. hiemalis f. hiemalis (= *M. varians* Povah):
CBS 233.29(-)

M. hiemalis f. hiemalis (= *M. vallesiacus* Lendner):
CBS 107.19(+)

M. hiemalis f. luteus (Linneman) Schipper
(= *M. luteus* Linneman): CBS 243.35(+), CBS 244.35(-)

M. hiemalis f. silvaticus (Hagem) Schipper
(= *M. silvaticus* Hagem): CBS 249.35(+), CBS 250.35(-)

M. odoratus Treschow:
CBS 130.41

M. varians Povah:
ATCC 18361

Explanation of abbreviations:

ATCC = American Type Culture Collection
CBS = Centraalbureau voor Schimmelcultures
F = Farlow Herbarium, Harvard University
UNB = University of Nebraska, Lincoln

(Schipper, 1973, p. 19). The present study was undertaken to determine whether there is a correlation between successful matings and isozyme similarity.

MATERIALS AND METHODS

The isolates studied, their mating type, and origin are listed in Table I. Mating type was determined by mating trials with ATCC 8977a (+) and 8977b (-). The Centraalbureau voor Schimmelcultures (CBS) isolates were used by Schipper (1973) in her taxonomic study of the section. In some cases the mating type designation disagrees with that given by Schipper. The University of Nebraska-Lincoln (UNB) isolates were obtained through the courtesy of Dr. Wendell Gauger. Farlow Herbarium (F) strains were collected from locations in Massachusetts by the author, and identified as *Mucor hiemalis* because of their ability to form zygospores with ATCC 8977a or 8977b. These two ATCC cultures were chosen as testers because they were used by Cutter in his cytological studies (Cutter, 1942).

Stock cultures were grown on Potato Dextrose Agar (PDA, Difco) and stored at 4°C. Mating tests were performed following the recommendations of Schipper (1973), however, PDA was used for most of the trials, rather than Beerwort Agar.

To prepare material for electrophoresis, isolates were cultured on a reciprocating shaker, 100 shakes per minute, at room temperature (± 20°C) for 48 hours in 250 ml flasks. One hundred ml of Mycological Broth (Difco) plus 0.3% Yeast Extract (Difco) was used as a culture medium. Mycelium was collected on filter paper by vacuum filtration in a Buchner funnel; washed with water and 0.1 M TRIS Borate EDTA, pH 8.9; and blotted dry. The dried mycelium was stored frozen (-20°C) for a maximum of 30 days.

Proteins were extracted by grinding 1 g of mycelium in 1 ml of 0.1 M TRIS Borate EDTA, pH 8.9, with 5% Sucrose. Grinding was done with sand in a mortar and pestle in an ice bath. The mycelium/buffer mixture was centrifuged at 7,000 g for 30 min. The resulting supernatant was used for electrophoresis.

Electrophoresis was carried out on vertical gels of 5% Acrylamide in 0.1 M TRIS Borate EDTA, pH 8.9, cooled by

TABLE II

MATING REACTIONS OF SOME MUCOR HIEMALIS ISOLATES[1]

PLUS MINUS	ATCC 8977b	CBS 200.28	CBS 233.29	CBS 244.35	CBS 250.35	F429	F434	F447	F517	F541	UNB-6
ATCC 8977a	Z	Z	G	0	Z	Z	Z	Z	Z	Z	Z
ATCC 18361	Z	0	0	0	0	0	Z	0	0	0	Z
CBS 107.19	G	0	0	0	0	0	G	0	0	0	G
CBS 201.28	Z	Z	0	0	0	Z	Z	G	G	Z	Z
CBS 224.29	G/Z	Z	0	0	0	Z	G	0	0	0	G
CBS 229.35	Z	0	0	0	0	Z	G	Z	Z	0	G
CBS 243.35	G	Z	0	Z	0	0	G	G	0	0	G
CBS 249.35	0	Z	0	0	G/Z	Z	G	0	G	Z	0
F461	Z	Z	0	G	G	Z	Z	Z	Z	Z	Z
F466	Z	Z	0	0	0	Z	Z	Z	Z	Z	Z
F477	Z	Z	0	0	0	Z	Z	G	0	Z	Z
F511	Z	Z	0	0	0	Z	Z	Z	Z	Z	Z
F520	Z	0	0	0	0	Z	Z	Z	Z	Z	Z
F525	Z	0	0	0	0	Z	Z	Z	Z	Z	Z
F526	Z	Z	0	0	0	Z	Z	G	0	Z	Z
F546	Z	Z	0	0	G	Z	Z	Z	Z	Z	Z
F547	Z	Z	0	0	0	Z	Z	Z	Z	Z	Z
UNB-5	Z	Z	0	G	Z	Z	Z	Z	Z	Z	Z
UNB R107	Z	Z	0	G	G	Z	Z	Z	Z	Z	Z

Explanation of Abbreviations:

Z = zygospores formed
G = gametangial initials (progametangia) formed
0 = no reaction

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[1] CBS 130.41 did not react with any other isolates and is therefore omitted from the above table.

a constantly circulating solution of Ethylene Glycol (14%) in water at -4°C. All gels were run for three hours at 250 V, producing less than 100 ma of current.

To stain for each set of isozymes, gels were immersed in the following mixtures on a platform shaker:

Alcohol dehydrogenase (ADH): 100 ml of 0.1 M TRIS HCl, pH 8.5; 30 mg Nicotinamide adenine dinucleotide (NAD); 25 mg Nitro Blue Tetrazolium salts (NBT); 1 ml Hexanol; 1 ml Phenazine methylsulfate in water, 2 mg/ml (PMS).

Benzaldehyde oxidase (BO): 100 ml of 0.1 M TRIS HCl, pH 8.5; 26 mg NBT; 2 ml PMS; 3 ml Benzaldehyde.

α-Esterase: Incubate gel in 0.5 M Botic acid for one hour in refrigerator, then wash with water, stain in mixture of 50 mg Fast Red TR salt, 100 ml of 0.1 M Phosphate Buffer, pH 6.5; 20 mg α-napthyl acetate dissolved in 1 ml 50% Acetone in water, for 1 1/2 hours.

Lactic dehydrogenase (LDH): 100 ml of 0.1 M TRIS HCl pH 8.5, 40 mg NAD, 70 mg NBT, 20 ml of 1 M solution of Sodium Lactate; 2 ml PMS.

Malic dehydrogenase (MDH): 10 ml of 1 M L-Malic acid, 10 ml 1 M TRIS HCl pH 8.5, 80 ml water, 15 mg NAD, 50 mg NBT, 1 ml PMS.

All tests were repeated at least three times. As a further control, 20 single spore isolates of ATCC 8977a were grown and tested simultaneously. All gave identical patterns for all enzymes.

RESULTS

Mating reactions of the isolates studied are given in Table II. Some of these crosses are repeats of Schipper's (1973) mating experiments. Corrected for the differences in mating type designation (determined by reaction with ATCC 8977a and 8977b) the repeated crosses agree with her results.

To gauge how closely related one isolate is to the rest of the isolates, I calculated "mating potency" as:

$$\text{mating potency} = \frac{2Z + G}{N}$$

Z = the number of crosses in which zygospores were formed; G = the number of crosses in which gametangial initials were formed; and N = the total number of crosses (including crosses in which there were no interactions). Thus, for an isolate that formed zygospres in all crosses, the mating potency would be 2. The last column of Table III gives the mating potencies for all the isolates.

For each of the six enzymes studied, between four and 16 different isozyme patterns were distinguishable for the 31 isolates. All the isolates were grouped according to their pattern type. The letter designation for the pattern that each isolate showed for each enzyme studied is given in Table III. Diagrams of patterns for representatives of each lettered group are shown in Figures 1-6.

The most variation was present in α-Esterases, which showed 16 different patterns for the 31 isolates. Tetrazolium oxidase (T.O.) showed only 4 different patterns. Lactic dehydrogenase pattern F is a "null allele"; that is, no band appeared under the given experimental conditions.

Figure 7 is a dendrogram made from a single linkage cluster analysis (Sneath and Sokal, 1975) of the electrophoretic data of Table III. Vertical lines represent the degree of similarity between isolates, calculated by comparing all the electrophoretic patterns of each isolate with the patterns of every other isolate. Numbers in parentheses by certain of the vertical lines indicate the average mating potency for the isolates connected at that degree of similarity. To facilitate discussion, the four main clusters have been identified by letters (a, b, c, d).

The dendrogram shows that, in general, the average mating potency is high in groups of isolates that are electrophoretically similar. For group a, with 22 members, the average mating potency within the group is 1.8, implying that zygospores were formed in almost all of the intragroup crosses. The isolates in this cluster show identical patterns for at least three of the six enzymes studied. Morphologically, the group is extremely variable; for example, one of the isolates (ATCC 18361) is listed as *M. varians* in the ATCC catalogue.

On the basis of morphological comparison alone it is difficult to decide into which forma some of the Farlow Herbarium isolates should be placed; however, on the basis

TABLE III

Isozyme patterns shown by 31 *Mucor* isolates for six different stains. The letters under each enzyme indicate the pattern that an isolate showed for that stain. Diagrams of representatives of each pattern type are shown in Figures 1-6. The last column in the table shows the mating potency for each isolate.

ISOLATE ENZYME	ESTER-ASE	B.O.	T.O.	ADH	MDH	LDH	MATING POTENCY
8977a	A	A	A	A	A	A	1.73
8977b	B	A	A	A	A	A	1.79
18361	C	A	A	A	A	B	0.54
107.19	D	B	B	A	B	C	0.27
130.41	E	C	C	B	C	D	0.0
200.28	F	A	A	A	D	E	1.47
201.28	G	A	A	A	D	E	1.27
224.29	D	B	D	A	B	C	0.73
229.35	D	B	D	C	B	F	0.91
233.29	H	B	D	C	B	F	0.05
243.35	I	D	D	D	E	F	0.73
244.35	J	D	D	D	E	F	0.26
249.35	K	E	D	E	F	F	0.91
250.35	K	E	D	E	F	F	0.47
429	C	A	A	F	G	B	1.68
434	L	A	A	A	G	F	1.74
447	C	A	A	F	B	B	1.37
461	M	A	A	A	B	F	1.64
466	C	A	A	F	G	B	1.45
477	C	A	A	F	G	B	1.18
511	C	A	A	A	G	B	1.45
517	C	A	A	F	G	B	1.26
520	C	A	A	F	G	B	1.27
525	C	A	A	F	G	B	1.27
526	N	A	A	A	G	B	1.18
541	C	A	A	F	B	B	1.47
546	O	A	A	F	B	B	1.54
547	O	A	A	F	G	B	1.45
5	P	A	A	A	G	F	1.73
6	P	A	A	A	H	F	1.68
R107	P	A	A	A	H	F	1.63

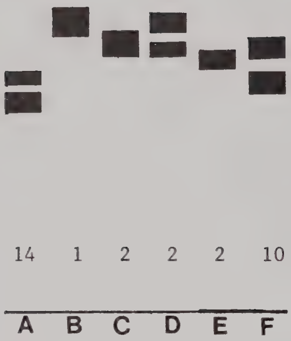

14
1
2
2
2
10
A
B
C
D
E
F

Fig. 1. Alcohol Dehydrogenase banding patterns.

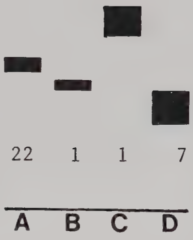


Fig. 2. Tetrazolium Oxidase banding patterns.

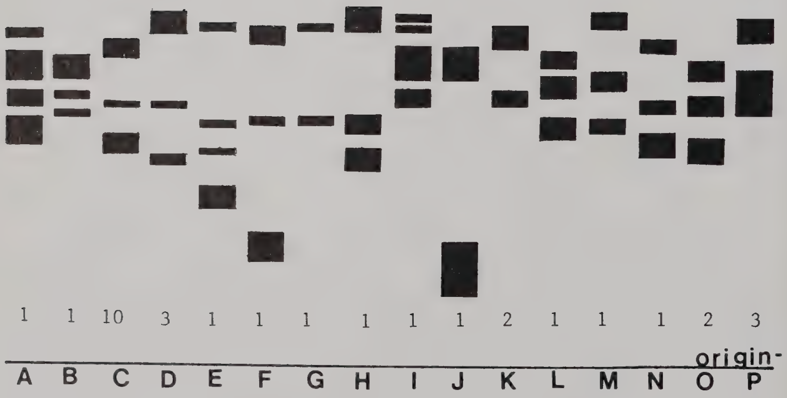

1
1
10
3
1
1
1
1
1
1
2
1
1
1
2
3
origin
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P

Fig. 3. α-Esterase banding patterns.

Fig. 1-6. Diagrams of isozyme banding patterns for representatives of each pattern group, for each enzyme, as indicated. The numerals below each pattern indicate the number of isolates in that group.

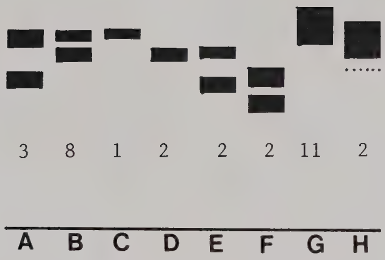

3 8 1 2 2 2 11 2
A B C D E F G H

Fig. 4. Malic Dehydrogenase banding patterns.

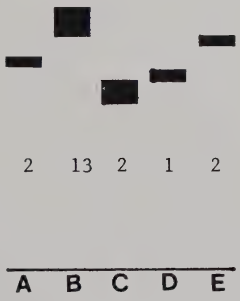

2 13 2 1 2
A B C D E

Fig. 5. Lactic Dehydrogenase banding Patterns.

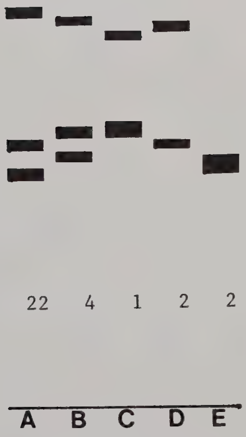

22 4 1 2 2
A B C D E

Fig. 6. Benzaldehyde Oxidase banding patterns.

of this study, they should all be considered *M. hiemalis f. hiemalis*.

The two isolates of *M. hiemalis f. luteus* (CBS 243.35 and 244.35) differ from each other only by one α-Esterase band. They form zygospores when crossed, as do the two members of cluster c, both isolates of *M. hiemalis f. silvaticus*. These isolates (CBS 249.35 and 250.35) are electrophoretically identical.

The isolates of cluster d do not interact at all in mating tests. Schipper (1973) also notes their lack of sexual interaction, but places them in the forma *hiemalis* because of their morphological similarity. The electrophoretic clustering of these isolates also indicates their inter-relatedness, but their relative distance from cluster a casts doubt on their inclusion in the same forma as CBS 200.28 and 201.28.

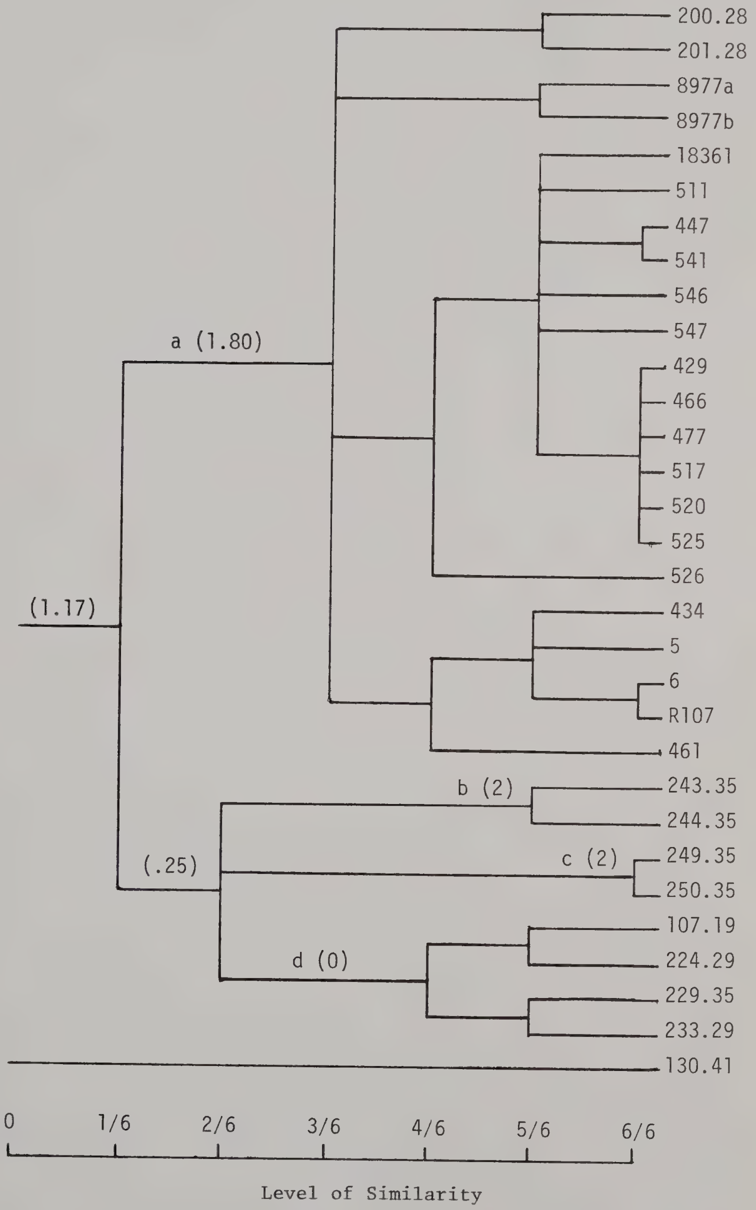
Mucor odoratus Treschow (CBS 130.41) is completely separated from the *M. hiemalis* complex both on the basis of electrophoretic similarity and mating potency (both are zero).

For the 31 isolates studied, the correlation between mating potency and electrophoretic similarity is 0.61 ($p<<.001$). There is no correlation between mating type, substrate of isolation, and isozyme pattern.

DISCUSSION

The lettered clusters of isolates in Figure 7 are only related at the 1/6 level of similarity. Such large intergroup differences could be interpreted to mean that each group of isolates should be considered a separate species. However, mating tests, based on the assumption that zygospore formation is an indicator of interfertility, showed that these 30 isolates are members of one interfertile group. Even though zygospores were not germinated, it is well established that in the genus *Mucor* zygospores are only formed in crosses of conspecific individuals. In crosses between isolates from different species, only progametangia or gametangia are formed (Blakeslee, 1915, 1920; Blakeslee and Cartledge, 1927; Satina and Blakeslee, 1930; Ling-Young, 1930; Schipper, 1973). Therefore, the 30 isolates that formed zygospores in this study must be placed in a single species, and the electrophoretic differences

Fig. 7. Dendrogram showing relationships between 31 *Mucor* isolates.


200.28
201.28
8977a
8977b
18361
511
447
541
546
547
429
466
477
517
520
525
526
434
5
6
R107
461
243.35
244.35
249.35
250.35
107.19
224.29
229.35
233.29
130.41
a (1.80)
(1.17)
b (2)
(.25)
c (2)
d (0)
0
1/6
2/6
3/6
4/6
5/6
6/6
Level of Similarity

cannot be judged large enough to define different species. However, the differences can be used to distinguish formae of the same species. As previously pointed out, these electrophoretically determined formae are generally the same as the morphologically distinct groupings proposed by Schipper (1973).

The large amount of electrophoretic dissimilarity can be attributed to three things. First, acrylamide gel electrophoresis is an extremely sensitive technique that shows very small differences in protein structure (single amino acid substitutions are detectable). It may be that not all of these differences are important enough to be the basis for separating groups of isolates into species: they could be attributed to "normal intraspecific variation". Milkman (1973) working with *Escherichia coli* and Speith (1975) with *Neurospora intermedia* found essentially the same amount of intraspecific variation in those organisms as is shown for *Mucor hiemalis*.

Second, the choice of enzymes studied may have prejudiced the results by artificially increasing variation observed. Different enzymes show different amounts of variation. Had other, more stable, enzymes been studied, instead of α-Esterase, for example, which is known to be variable in a number of organisms (Peberdy and Turner, 1968), the general degree of similarity would have increased somewhat.

Third, scoring the gels by pattern type instead of band by band tends to increase the observed differences between isolates. For example, consider two patterns, each with four bands. Even if they differ in only one band they are judged to be completely different in a pattern type comparison, but in a band by band comparison they would be either 7/8 (87%) or 3/4 (75%) the same. However, since the chromosome structure of *M. hiemalis* is unknown, it is impossible to compare zymograms on a band-by-band basis, because one can never tell if different mobilities are caused by genes at different loci, or just different alleles of the same gene. A correct interpretation of electrophoretic results depends on not fabricating "presumed loci" unless it is possible to prove their constancy by showing segregation in mating experiments.

This study shows that electrophoretic similarity is a useful indicator of taxonomic similarity. Clusters of electrophoretically related individuals may occur at the subspecific level, while all the members of a species show less homogeneous isozyme patterns. Large differences (that is, zero similarity) indicate at least a species distinction. Results can be strongly biased by the choice of enzymes studied, and by the method of scoring gels. Careful interpretation of electrophoretic data should take both of these factors into account.

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THE GENUS COPRINUS IN WESTERN NORTH AMERICA, PART I: SECTION COPRINUS[1]

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SUMMARY

In this first paper of a series on western North American species of Coprinus, 10 species and 3 varieties comprising the section Coprinus, are considered. Of these only C. comatus var. comatus has been previously reported in regional handbooks. Eight new species, C. arachnoideus, C. spadiceisporus, C. xerophilus, C. colosseus, C. asterophoroides, C. palmeranus, C. roseistipitatus, and C. alnivorus are described. Three new varieties of C. comatus, var. parvus, var. excentricus, and var. caprimammillatus are described. One species, C. umbrinus, is reported for the first time from North America. A key to the species and varieties found in western North America is provided.

INTRODUCTION

There is no complete monographic study of Coprinus in the modern sense. For North America, the only treatment is that of L. H. Pennington in C. H. Kauffman's Agaricaceae of Michigan (1918). However, for use in western North America, Kauffman's work has its limitations. It covers an area very different in climate, geography, and vegetation, and no consideration is given to microscopical details other than spore size and shape.

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[1] This paper is based in part on a thesis submitted to the Graduate School of the University of Washington in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

This study represents the first treatment of Coprinus, section Coprinus, as it occurs in Washington and other western states having similar geography and plant associations.

The concept of infrageneric taxa followed here is essentially that of Kühner and Romagnesi (1953) which emphasizes the nature of the pileal surface below the universal veil and the nature of the universal veil and its elements.

MATERIALS AND METHODS

The materials used included collections from the herbaria of the University of Washington and Central Washington State College as well as fresh collections from a variety of locations. Preliminary data were, in most cases, obtained from fresh collections which were then either dried while still in the field using a modification of the silica-gel method of Hoseney (1963) or were immediately dried in a heated, forced-draft drier. This procedure is necessary due to the extreme fragility of most Coprinus species and their rapid deliquescence which would otherwise destroy the usefulness of the collection. Collections of coprophilous species were obtained by incubation of dung samples in the laboratory.

All microscopical data were obtained from dried material. Each collection was examined microscopically with a Zeiss Standard GFL microscope. The microscopical characters examined included spores, basidia, clamp connections, pileal surface, universal veil, and cell ornamentation. For most of these data a simple squash-mount technique was satisfactory. Pileal surface scalp sections or radial sections were used to determine the nature of the pileal surface and universal veil. The material to be examined was wetted with 95% ethanol and then placed in 3% KOH or in 3% KOH to which a small drop of 1% aqueous Congo Red was added. The section was allowed to soak for several minutes before being examined. Spores were examined in 3% KOH with no staining and were observed at least twice, at two to three minutes and then later at ten to fifteen minutes to determine any color change. Dorsoventrally or laterally compressed spores were measured in three dimensions, length, width, and breadth.

Drawings were made using a Zeiss camera lucida, and the collections used are indicated by an asterisk (*).

All collections examined are deposited in the Mycological Herbarium of the University of Washington (WTU) or of Central Washington State College (ELRG).

TERMINOLOGY

The terminology used is essentially that of Snell and Dick (1957). Color terminology is that of Kornerup and Wanscher (1967). Several unusual terms are: glandiform, referring to the ovate and somewhat basally truncate acornlike shape of some young pilei; ululiform is roughly clavate but modified by a waist constriction and refers to the shape of some long basidia; brachybasidioles are short, squat, permanently sterile cells that serve as spacing elements in the hymenium of all _Coprinus_ species.

Coprinus Pers. per S. F. Gray, Section _Coprinus_
= Comati Fr. (1838) em. Lange, Dansk. Bot. Ark. Bd. 2 No. 3, p. 36. 1915.
= Pelliculosi (Fr. 1838 ut tribus) em. Schröter, Pilze, p. 521. 1889.

Pileal surface outside of the apical disk composed of radially oriented hyphae, covered with and sometimes obscured by a universal veil of fibrils, often until late maturity. No sphaerocysts in the universal veil. No erect pileocystidia or caulocystidia, and usually no pleurocystidia. Definite annulus present, either free or attached to the base of the stipe like a volva and not reduced to a small bulge or flange. Stipe lumen generally with a yarnlike or weblike mass of loose hyphae. Sporocarp of medium to very large size and always undergoing autodigestion. Spores usually large, 10-25 µm in length, smooth walled. Species growing on dung or soil, rarely on wood, especially in disturbed areas.

TYPE SPECIES: *Coprinus comatus* O. F. Müller per S. F. Gray, Nat. Arrang. Brit. Pl. 1:632. 1821.

Observations: The distinguishing characters of section *Coprinus* are the pileal surface of radially oriented hyphae, the universal veil of mostly unbranched nondiverticulate hyphae with no sphaerocysts present, the abundance and loose nature of the veil when mature, the conspicuous annulus or volva and the lack of pleurocystidia in most species. The several species reported for this section seem to form a rather closely related group. Two species, *Coprinus arachnoideus* and *C. alnivorus*, appear to be transitional to section *Lanatuli* in the nature of the universal veil and in the completely empty stipe lumen of *C. arachnoideus*.

Coprinus comatus has been found to be somewhat variable. Of the several varieties presented below, one is considered to be typical *C. comatus* var. *comatus*; however, until a neotype is declared, the concept of *C. comatus* will remain somewhat nebulous.

KEY TO TAXA OF SECTION *COPRINUS*

A. Stipe lumen without a weblike or yarnlike mass of loose hyphae inside
1. *Coprinus arachnoideus*

A. Stipe lumen with a weblike or yarnlike mass of loose hyphae inside

B. Basidiocarps lignicolous 2. *Coprinus alnivorus*

B. Basidiocarps coprophilous or terrestrial

C. Spores 8.0-10.0 µm long, contents never finely granular

D. Spores clear translucent, light brown microscopically; coprophilous
3. *Coprinus spadiceisporus*

D. Spores dark, purplish grey microscopically; terrestrial 4. *Coprinus palmeranus*

C. Spores (8.1-)9.8-22.0(-25.0) µm long, contents often finely granular or even guttulate

E. Basidiocarps inhabiting dry semidesert areas, not coprophilous

F. Pileal universal veil remnant a single stellate patch 5. *Coprinus asterophoroides*

F. Pileal universal veil remnant an irregular patch or several small patches 6. *Coprinus xerophilus*

E. Basidiocarps inhabiting moister climatic areas, sometimes coprophilous

G. Basidiocarps small, pileus 1.2-2.5 cm long, species coprophilous

H. Stipe white at apex and pale umber at base 7. *Coprinus umbrinus*

H. Stipe pink at apex and white at base 8. *Coprinus roseistipitatus*

G. Basidiocarps larger, pileus 4.0-25.4 cm long; species not coprophilous

I. Stipe very long, up to 50.5 cm; spores 17.0-20.0 μm long 9. *Coprinus colosseus*

I. Stipe shorter, up to 21.0 cm (one 32 cm); spores (8.1-)9.8-15.4(-18.0) μm long

J. Sterigmata of basidia hyaline and not darkened by a thick refractive plug; basidiocarps small, pileus 4.0-5.0 cm long prior to expansion, stipe attaining ultimate length of 5.0-6.0 cm 11. *Coprinus comatus* var. *parvus*

J. Sterigmata of basidia containing a somewhat dark and refractive plug; basidiocarps medium to large size, pileus (5.5-)6.0-12.0 cm long prior to expansion, stipe length 7.0-21.0 cm

K. Germ pore of all spores always apical in position 10. *Coprinus comatus* var. *comatus*

K. Some or all spores with germ pore eccentric in position

L. Germ pores of spores very eccentric in position, spores 14.0-18.0 µm long
12. *Coprinus comatus* var. *excentricus*

L. Germ pores of spores mixed apical to somewhat eccentric in position, spores (8.1-)9.8-14.0(-15.4) µm long
13. *Coprinus comatus* var. *caprimammillatus*

1. *Coprinus arachnoideus* VAN DE BOGART sp. nov. (Fig. 1)

Pileus primo elongato-glandiformis, dein campanulatus, primo 1.8 cm longus, post expansionem 3.0 cm latus, e pallide cremeialbo pallide griseialutaceus vel pallide cremeigriseialutaceus, in maturitate tenuiter plicatostriatus; velum universale tenue, fibrosum, in maturitate fragmenta dispersa formans, carne tenui, membranacea; stipes cavus, gracilis, 4.0-6.5 cm longus, 2.2-3.6 mm crassus, e basi leviter tumida apicem versus parum angustatus, glaber sed basi aliquantum tomentosa, carne tenui, fragili; lamellae lineares, late adnatae, aggregatae, primo albae, dein atrae; autolysis completa.

Sporae laeves, complanatae, dorsaliter ovatae, lateraliter ellipsoideae, 11.2-13.8 x 7.5-8.8 x 6.2-7.3 µm, poro germinationis excentrico; basidia dimorpha, tetraspora; basidia breviter clavata 22.0-25.0 µm longa, 12.0 µm crassa; basidia longe clavata 30.2-35.2 µm longa, 13.0-15.0 µm crassa; cheilocystidia sphaerica vel ellipsoidalia, 12.5 µm usque ad 50.0 µm longa, 39.0 µm crassa, pro maxima parte breviter pedicellata, 3.0-6.0 µm longa, hyalina, laevia; pleurocystidia ellipsoidalia, 77.0-98.4 µm longa, 42.5-58.0 µm crassa, pedicellata, 1.0-12.0 µm longa, hyalina, laevia; pagina pilei cellulis radialiter duplo vel triplo longioribus quam latioribus; velum universale superficiei pilei et basis stipitis catenarum longarum intertextarum cellularum constantium, cellulis cylindraceis vel irregularibus vel ramosis, hyalinis, tenuitunicatis interdum tumidis et ad septis constrictis, amplitudibus valde variabilibus, 16.2-112.5 µm longis, 2.5-33.8 µm crassis, fibulae desunt.

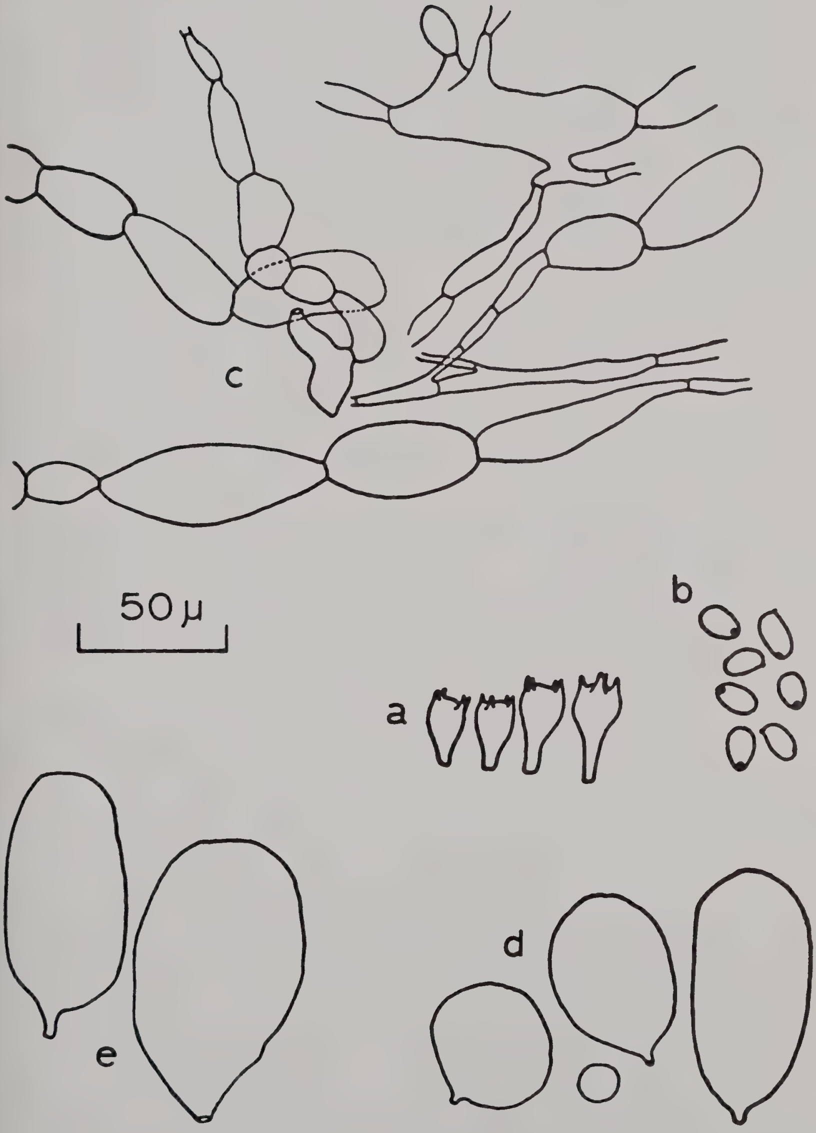

Fig. 1. Coprinus arachnoideus FVDB 2161, a. basidia, b. spores, c. universal veil, d. cheilocystidia, e. pleurocystidia.

Holotypus FVDB 2161 in solo tepidarii, Seattle, comitato King, pago Washingtonis, Mar., 1950, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first long glandiform, then conic, then campanulate. Prior to expansion 1.8 cm in length and after expansion 3.0 cm in breadth. Pale creamy white at first, soon becoming pale grey-tan to pale creamy grey-tan. Small shallow plicate striations developing as pileus becomes mature. Surface covered at first with a thin wispy fibrillar universal veil that soon breaks up into small scattered irregular patches. Flesh thin and membranous.

STIPE hollow, slender, nearly equal but with a slight swelling at the base and slightly narrowed towards the apex, 4.0-6.5 cm x 2.2-3.6 mm. White, opaque, glabrous except for a few small bits of loosely interwoven fibrillose tomentum scattered around the stipe base. Flesh thin and fragile.

LAMELLAE linear, some short lamellae present, 0.6-1.6 cm x 5.0 mm, broadly adnate, crowded, with no appreciable spreading by the limited amount of plicate striation, white, then soot black. Autolysis complete.

ODOR AND TASTE not observed.

SPORES ovate in dorsal view and ellipsoidal in lateral view, flattened, 11.2-13.8 x 7.5-8.8 x 6.2-7.3 µm, suprahilar depression present on most, apiculus small, visible only in lateral view, germ pore eccentric, 1.3-1.8 µm in diameter. Color en masse black, microscopically deep purple-brown in 3% KOH. Wall smooth.

BASIDIA dimorphic, short clavate and 22.0-25.0 x 12.0 µm, long clavate and 30.2-35.2 x 13.0-15.0 µm, all four-spored.

CYSTIDIA: Cheilocystidia globose to ellipsoidal, 12.5 µm in diameter to 50.0 x 39.0 µm, mostly with a short pedicel 3.0-6.0 µm long, hyaline, smooth. Pleurocystidia ellipsoidal, 77.0-98.2 x 42.5-58.0 µm, pedicellate, pedicels 1.0-12.0 µm long, hyaline, smooth. No other cystidia present.

PILEAL SURFACE a cutis of more or less radially oriented hyphae, the surface cells two or three times as long in the radial orientation as in any other direction.

UNIVERSAL VEIL of fibrillar nature, interwoven. Individual elements occurring in long chains of more or less cylindrical cells, hyaline, thin walled, some swollen and somewhat constricted at the septations, others not swollen. Some cells irregular, the chains composed of cells of varied sizes all along its length, some of them branched or anastomosed. The same types of chains of cells found on both the pileal surface and at the stipe base. Universal veil cell size 16.2-112.5 x 2.5-33.8 µm.

CLAMP CONNECTIONS absent.

HABITAT terrestrial, on prepared soil mixes in a greenhouse, solitary.

Observations: This species differs from most of the other species of section Coprinus in its lack of any web or thread of hyphae inside the lumen of the stipe, its lack of refractive plugs in the sterigmata, its adnate lamellae, and its lack of clamp connections. C. arachnoideus differs from C. alnivorus microscopically. It resembles some of the species of section Lanatuli in its universal veil characters and in the possession of pleurocystidia.

Material Examined. Washington: HOLOTYPE, FVDB 2161*, March, 1950.

2. Coprinus alnivorus VAN DE BOGART sp. nov. (Fig. 2)

Pileus primo breviter glandiformis, dein campanulatus, postremo laciniatus et aliquantum revolutus, primo 2.0 cm longus, post expansionem 2.0 cm latus, primo albus et ad apicem pallidibrunneus, dein griseascens, postrema ater, sed ad apicem solummodo griseibrunneus, pagina pilei primo velo universali tenui arachnoideo et minute squamuloso obtecta, in maturitate velo arachnoideo pro parte maxima evanescenti sed squamis minutis persistentibus etsi dispersis; pagina pilei in maturitate leviter plicato-striata, carne tenui et fragili; stipes gracilis, versus apicem leviter angustatus, 9.0 cm longus, 4.0-6.0 mm crassus, cavus, telam hypharum laxis capiens, pagina stipitis laevis, glabra, alba; annulus laxus et membranaceus, albus, friabilissimus et mox in

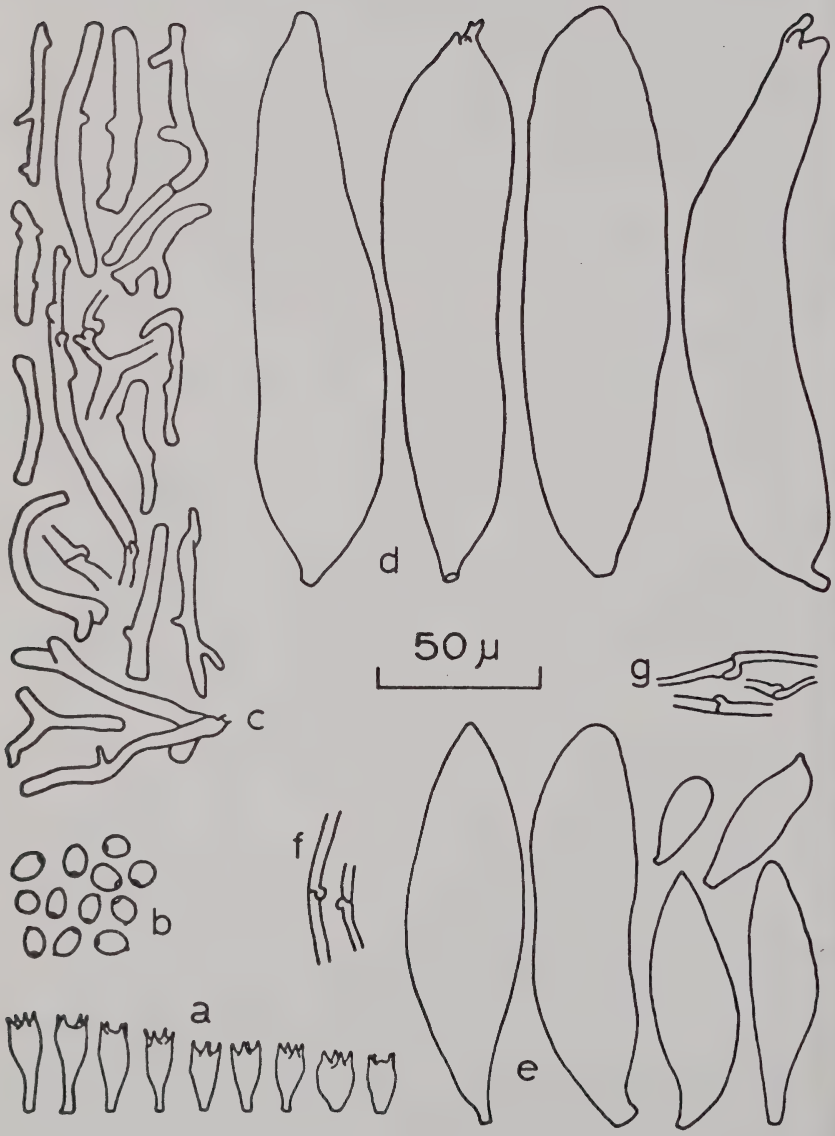

Fig. 2. Coprinus alnivorus FVDB 3370, a. basidia, b. spores, c. universal veil, d. pleurocystidia, e. cheilocystidia, f. stipe base clamp connections, g. lamellar clamp connections.

fragmentis parvis fatiscens, carne stipitis leviter fibrosa sed fragilissima; lamellae lanceolatae, liberae, confertae, primo albae, dein atrae, autolyse completo.

Sporae subglobosae vel breviter ellipsoideae variantes, 7.5-10.7 x 6.2-7.5 µm, poro germinationis apicali, in cumulo atrae, dein per microscoporium atropurpureae vel brunneipurpureae, in solutione 3% KOH atrae; basidia trimorphica, tetraspora; basidia breviter clavata 16.5-17.5 µm longa, 8.0-10.5 µm crassa; basidia clavata 18.0-26.0 µm longa, 8.0-9.0 µm crassa; basidia longe clavata pedicellata 27.0-29.0 µm longa, 8.0-9.0 µm crassa; cheilocystidia clavata, ellipsoideofusiformia, apicibus obtusis vel subacutis, 28.0 135.0 µm longa, 11.0-35.0 µm crassa, hyalina, tenuitunicata, laevia; pleurocystidia ellipsoidea vel subfusiformia, apicibus obtusis vel leviter ramificantibus, 145.0-182.0 µm longa, 30.0-45.0 µm crassa, hyalina, tenuitunicata, laevia; pagina pilei ex hyphis gracilibus, tenuitunicatis, cylindraceis, hyalinis constans, hyphae paginae radiantes; velum universale ex squamis parvis et tela tenui arachnoidea constans, velum in pagina pilei et basi stipitis praesens, squamis et telis ex hyphis intertextissimis, gracilibus, haud tumidis, tenuitunicatis, hyalinis, cylindraceis, septatis, et fibuligeris constantes, cellulis hypharum aliquantum ramificantibus, pro parte maxima ad septos facile secedentibus, 2.5-10.0 µm latis; squamae nonnullae paginam membranaceam habentes; annulus 1.0 mm latus; fibulae basi stipitis, in velo universali, in trama lamellarum adsunt; sporocarpia odore fungorum.

Holotypus FVDB 3370 in ligno alni, in sylva humida, Cispus Center, Gifford Pinchot National Forest, comitato Lewis, pago Washingtonis, 25 Oct., 1975, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first short-glandiform, then campanulate, then margin becoming laciniate and somewhat revolute, when unexpanded 2.0 cm in length, expanding to 2.0 cm in width. At first white except pale brown at the apex, then becoming grey, then black, but only brownish grey at the apex. Surface at first with a thin arachnoid universal veil with some minute squamules, in maturity the arachnoid veil largely vanishing but the minute squamules persisting although scattered, surface eventually slightly plicate-striate. Pileal margin at first connected to the stipe with a prominent, scaly white annulus. Flesh thin

and fragile.

STIPE slender, tapering only slightly from base towards apex, 9.0 cm x 4.0-6.0 mm, hollow, lumen with some loosely interwoven hyphal webbing, surface smooth, glabrous, white. Flesh slightly fibrous, but very fragile. Loose membranous annulus present, 1.0 mm in width, white, very friable and soon disintegrating into small fragments.

LAMELLAE lanceolate, free, very crowded, at first white, then black. Autolysis complete.

ODOR faint odor of mushrooms.

SPORES subglobose to short ellipsoidal, 7.5-10.7 x 6.2-7.5 µm, apiculus small, often not visible, germ pore apical, 1.5 µm in diameter. Color soot black en masse and at first dark purple or brownish purple microscopically, then soon black and opaque in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 16.5-17.5 x 8.0-10.5 µm, clavate and 18.0-26.0 x 8.0-9.0 µm, long-pedicellate-clavate and 27.0-29.0 x 8.0-9.0 µm, all four-spored.

CYSTIDIA: Cheilocystidia clavate to ellipsoidal-fusiform, apices obtuse to subacute, 28.0-135.0 x 11.0-35.0 µm; hyaline, thin walled, smooth. Pleurocystidia ellipsoidal to subfusiform, apices obtuse to slightly branching, 145.0-182.0 x 30.0-45.0 µm, hyaline, thin walled, smooth. No other cystidia present.

PILEAL SURFACE a cutis of slender, cylindrical, radially oriented, hyaline, thin walled hyphae.

UNIVERSAL VEIL of small scales and a thin arachnoid web on pileal surface and base of stipe, scales and web consisting of slender, nonswollen, thin walled, hyaline, cylindrical, septate and clamped hyphae, very interwoven, some branching, most cells separating readily at the septations, 2.5-10.0 µm in diameter, some scales with membranous surface.

CLAMP CONNECTIONS present on the hyphae of the stipe base, in the universal veil, and in the lamellar trama.

HABITAT lignicolous, on hard scarcely rotted wood of Alnus sp. in a hardwood rain forest.

Observations: This species is similar in many features to C. arachnoideus and likewise appears to be transitional to section Lanatuli in its veil characteristics and possession of pleurocystidia. It differs from C. arachnoideus in most of its microscopical features.

Material Examined. Washington: HOLOTYPE, FVDB 3370*, 25 October, 1975.

3. Coprinus spadiceisporus VAN DE BOGART sp. nov. (Fig. 3)

Pileus primo ovatus-ellipsoideus, dein campanulatus, postremo aliquantum revolutus, primo 3.0-3.8 cm longus, post expansionem 5.0-6.0 cm latus, primo albidus, dein propter sporas maturas atrogriseibrunneus; apex pallide brunneus, pagina plicato-striata, velo universali tecta; velum ex squamis parvis appressis constans, sordide albidum aetate laxum et magis dispersum tamen semper aliquantum persistens, carne tenui, membranacea; stipes aliquantum crassus, 10.0-12.0 cm longus, 5.0-8.0 mm crassus, cavus, tela hypharum laxarum capiens, annulo conspicuo laxo albo coacto, 1.0 mm lato, pagina laevis glabra, basi leviter tomentosa, primo albus, dein apice atranti, carne aliquantum crassa et fibrosa; lamellae lanceolatae, liberae et remotae, aggregatae, in maturitate brunneolae-atrae, autolysis completa.

Sporae laeves, aliquantum complanatae, ovato-ellipsoideae, 8.1-10.0 x 6.2-6.9 x 5.0-5.6 µm, in cumulo atrobrunneae, per microscopium badiae, translucidae, poro germinationis excentrico; basidia trimorphica, tetraspora; basidia breviter clavata 12.5-17.5 µm longa, 10.0-11.2 µm crassa; basidia longe clavata 20.0-25.0 µm longa, 10.0-11.2 µm crassa; basidia ululiformia 28.7-35.0 µm longa, 10.0-11.2 µm crassa; cheilocystidia sphaerica vel ellipsoidalia, 15.0 µm usque ad 42.5 µm longa, 30.0 µm crassa, hyphis tenuibus filamentosis mixtis, pagina pilei hypharum radialium; velum universale superficiei pilei ex catenis cellularum longis parallelis inramosis constantium, cellulis interdum tumidis et catenulatis, aliter

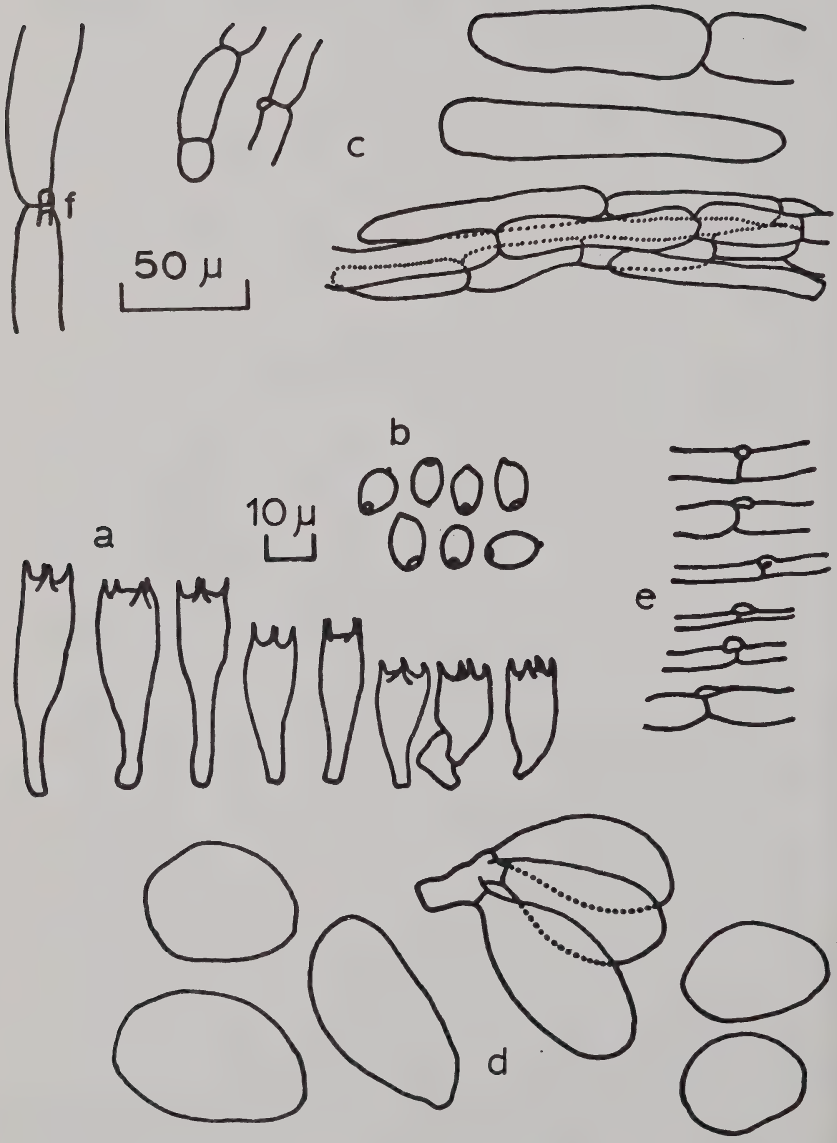

Fig. 3. Coprinus spadiceisporus FVDB 217, a. basidia X1000, b. spores X1000, c. universal veil X500, d. cheilocystidia X1000, e. stipe clamp connections X500, f. universal veil clamp connection X1000.

disjunctis et incohaerentibus, cellulis omnibus laevibus, tenuitunicatis, hyalinis, cellulis contiguis amplitudibus et formis similibus; fibulae in stipite et velo universali adsunt.

Holotypus FVDB 217 in stercore cuniculo vel cervo detrito mixto, pago Washingtonis occidentalis, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first ovate-ellipsoidal, then conical, then campanulate, and eventually somewhat revolute, when unexpanded from 3.0-3.8 cm long, expanding to 5.0 to 6.0 cm wide. Whitish when young but soon grey from ripening spores, the apex pale brownish, soon entirely dark greyish brown, except the apex which remains paler brown. Radial pileal striations apparent even at young stage and soon developing into plicate striations. Surface covered with a universal veil of small somewhat appressed scales of dingy or dirty white color, becoming much looser in age and more scattered but even then more or less persistent. Flesh rather thin and membranous. Leaves and debris stuck to pileal surface.

STIPE hollow, rather stout for Coprinus, 10.0-12.0 cm x 5.0-8.0 mm. Prominent, loose, white, felty annulus present, about 1 mm in width. Hollow center filled with a weblike mass of loose hyphae. Outer surface smooth and glabrous except for a loose tomentum of woolly hairs at the base. White in color at first but soon darkening to light brownish over most of its length and becoming dark, almost black near the apex, opaque. Flesh rather thick and fibrous for a Coprinus.

LAMELLAE lanceolate, 2.5 to 4.0 mm broad, free and remote, crowded, dark brownish black when mature. Autolysis complete.

SPORES ovate-ellipsoidal, slightly flattened, basal end broader than apical end, 8.1-10.0 x 6.2-6.9 x 5.0-5.6 μm, apiculus and germ pore both prominent, germ pore eccentric, 1.5-2.0 μm in diameter. Color dark blackish brown en masse and a clear translucent chestnut brown microscopically in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 12.5-17.5 x 10.0-11.2 μm, long clavate and 20.0-25.0 x 10.0-11.2 μm, ululiform and 28.7-35.0 x 10.0-11.2 μm, all four-spored.

CYSTIDIA: Cheilocystidia globose to more or less ovate, 15.0 µm in diameter to 42.5 x 30.0 µm, intermixed with thin filamentous hyphae on gill edge. No other cystidia present.

PILEAL SURFACE a cutis of radially oriented hyphae.

UNIVERSAL VEIL scales composed of fibrils aligned parallel to each other and composed of chains of unbranched, often swollen cells 6.2-20.0 µm in diameter, often constricted at the septations and then catenulate, also tending to break up into single loose cells. All cells of the universal veil with smooth, thin, hyaline walls, and all adjacent cells of the universal veil tending to be of similar size and shape.

CLAMP CONNECTIONS present on the hyphae of the stipe surface and occasionally on the universal veil.

HABITAT coprophilous, on rabbit or deer dung.

Observations: This species shares a peculiar feature with two other species of section _Coprinus_, _C. sterquilinus_ and _C. colosseus_, namely, the discoloring and eventual blackening of the apical portion of the stipe flesh. The ovate, flattened spores with their clear light brown color seem distinctive.

Material Examined. Washington: HOLOTYPE, FVDB 217*, collector and date unknown.

4. _Coprinus palmeranus_ VAN DE BOGART sp. nov.
(Fig. 4)

Pileus primo glandiformis, dein conicus, postea campanulatus, postremo revolutus, primo 3.2 cm longus, post expansionem 3.0 cm latus, primo ubique albus vel ad apicem subbrunneus, in maturitate cinereialbus, ad apicem brunneus, pagina pilei primo cum squamis parvis veli universalis obtecta, in maturitate squamae veli universalis dispersae et evanescentes, in maturitate pagina pilei leviter plicato-striata, carne tenui et membranacea; stipes cavus, tela hypharum laxarum capiens, gracilis, basi bulbosa, cum rhizomorphis gracilibus subtenta, apicem versus leviter contractus, 8.5 cm longus, 3.0-7.0

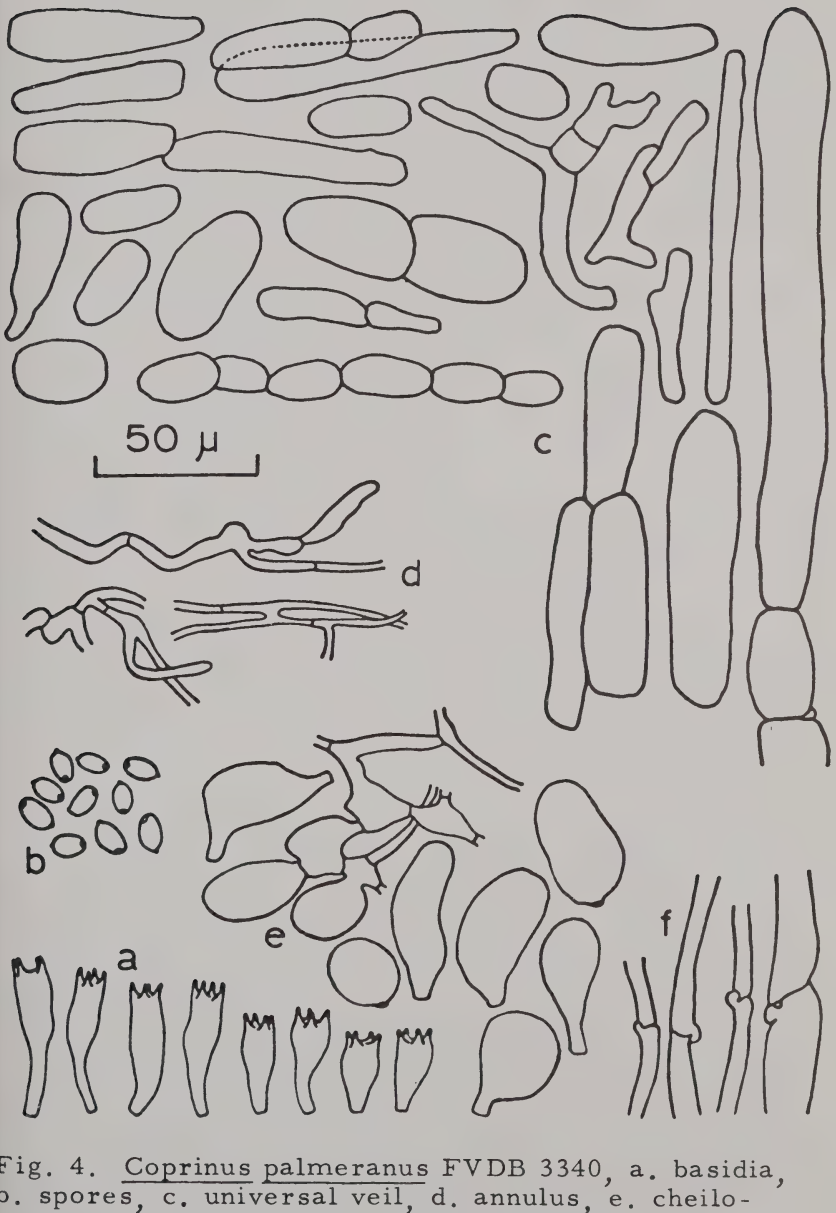

Fig. 4. Coprinus palmeranus FVDB 3340, a. basidia, b. spores, c. universal veil, d. annulus, e. cheilocystidia with associated hyphal structures, f. stipe clamp connections.

mm crassus, pagina stipitis pro parte maxima laevis, glabra vel fibrilis paucis laxis, area prope basin furfuraceae; stipes annulo parvo libero albo membranaceo praeditus, scapo albo carne aliquantum fibrosa etsi fragili; lamellae lanceolatae, liberae, confertae, primo albae, dein roseae, postea brunneae vel atrobrunneae, postremo atrae; autolysis completa.

Sporae moderate complanatae, lateraliter visae late ellipsoideae, dorsaliter visae anguste ovatae, 8.7-10.0 x 5.6-6.3 x 4.3-5.7 μm, poro germinationis leviter excentrico, in cumulo atrae, per microscopium atripurpureigriseae; basidia trimorphica, tetraspora; basidia breviter clavata 20.0-22.5 μm longa, 12.5 μm crassa; basidia clavata 31.2-37.5 μm longa, 10.0-11.3 μm crassa; basidia ululiformia 45.0-49.0 μm longa, 10.0-12.5 μm crassa; sterigmata obturamentis refractivis; cheilocystidia globosa, obovata, lageniformes, ellipsoidea, 10.0 μm usque ad 46.5 μm longa, 19.0 μm crassa; pagina pilei ex hyphis gracilibus tenuitunicatis hyalinis radiantibus constans; velum universale superficiei pilei ex squamis constans, squamis ex catenis parallelis cellularum constantibus, cellulis cylindracea interdum tumidis, et ad septa constictis, hyalinis, tenuitunicatis, 5.0-19.0 μm latis; annulus membranaceus, ex cellulis pro parte maxima gracilibus cylindraceis, hyalinis, tenuitunicatis et sparsim septatis constans, cellulis aliquantum intertextis et anastomosantibus, 2.5-11.5 μm latis; fibulae in contextu stipitis adsunt sed non frequentes.

Holotypus FVDB 3340 in solo argillaceo, Staircase, Olympic National Park, comitato Mason, pago Washingtonis, Oct., 1974, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first glandiform, then conic, then campanulate and becoming revolute, when unexpanded 3.2 cm in length, expanding to 3.0 cm in width. White and light brown at the apex when young, becoming grey-white and brown at the apex with maturity, covered at first with small scales of the universal veil, with maturity the universal veil scales becoming scattered and evanescent, slightly plicate striate where not covered with veil, margin at first attached to stipe by partial veil, flesh very thin and membranous.

STIPE hollow, the lumen stuffed with a loose

webbing of hyphae, slender, base bulbous with a slender subtending rhizomorph, shaft tapering slightly towards apex, 8.5 cm x 3.0-7.0 mm, surface smooth and mostly glabrous with an occasional loose fibril, white and opaque, base with a scurfy area and a small free white membranous annulus, flesh somewhat fibrous although fragile.

LAMELLAE lanceolate, free, very crowded, few short lamellulae present, at first white, then pink, then brown, then dark brown, then black. Autolysis complete.

SPORES moderately flattened, laterally broadly ellipsoidal, dorsally narrowly ovate, 8.7-10.0 x 5.6-6.3 x 4.3-5.7 µm, apiculus present, small, germ pore slightly eccentric, 1.8 µm in diameter. Color soot black en masse and a dark purplish grey microscopically in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 20.0-22.5 x 12.5 µm, clavate and 31.2-37.5 x 10.0-11.3 µm, ululiform and 45.0-49.0 x 10.0-12.5 µm, sterigmata with refractive plugs, all four-spored.

CYSTIDIA: Cheilocystidia globose, obovate, lageniform, and ellipsoidal, 10.0 µm in diameter to 46.5 x 19.0 µm. No other cystidia present.

PILEAL SURFACE a cutis of slender, radially oriented thin-walled hyaline hyphae.

UNIVERSAL VEIL scales composed of parallel chains of cells, cells cylindrical, some swollen and constricted at the septa, all hyaline, thin-walled 5.0-19.0 µm in diameter. Annulus membranous, composed of mostly slender cylindrical cells, sparsely septate, somewhat interwoven and anastomosed, hyaline, thin-walled, 2.5-11.5 µm in diameter.

CLAMP CONNECTIONS present in stipe context, not common.

HABITAT terrestrial, on clay soil in open grassy maple woods.

Observations: This species bears a striking resemblance to *C. comatus* in its overall appearance. It differs

mainly in its much smaller stature and the much smaller size of the spores and basidia.

Material Examined. Washington: HOLOTYPE, FVDB 3340*, October, 1974.

5. Coprinus asterophoroides VAN DE BOGART sp. nov. (Fig. 5)

Pileus primo rotundus, dein campanulatus, postea planiusculus, postremo pro parte maxima per lysem destructus, primo 2.0-3.0 cm longus, post expansionem 4.0-6.0 cm latus, propter velum universale primo albus, dein recedit velum, et cuticula ut videtur pallide grisea, dein atrescens vel brunneiatra, apice propter velum universale alba remanenti; velum universale crassissimum, consistentia coacta, mox vestigium persistens et distincte stellatum praebens; pagina pilei in maturitate profunde plicato-striata, margine revoluto vel subtus crispato, postremo ad frustilla laciniosa deminuto; stipes cavus, filum persistens hypharum capiens, gracilis, 7.0-11.5 cm longus, 3.0-6.0 mm crassus, pagina stipitis pro parte maxima laevis et glabra, prope basem fibrillis appressis, subinde squamis parvis in dimidio inferno stipitis, primo albus, lente denigricans, carne tenui fragili; lamellae lanceolatae, liberae et remotae, confertissimae, in maturitate atrifuligineae, autolyse completo.

Sporae ovatae vel ovato-ellipsoideae, leviter complanatae, 17.5-20.0 x 11.2-12.5 μm, poro germinationis apicali vel excentricissimo; basidia trimorphica, tetra spora; basidia breviter clavata 35.0-39.0 μm longa, 20.0-22.5 μm crassa; basidia clavata 50.0-54.0 μm longa, 20.0-22.5 μm crassa, basidia subululiformia 52.0-64.5 μm longa, 20.0-21.5 μm crassa; sterigmata obturamenta refractiva vel pigmentifera praebentia; apex basidii pigmento atrogriseibrunneo; pagina pilei ex hyphis radiantibus, cellulis numerosis paginae pigmentum atrobrunneum praeditis; velum universale superficiei pilei fragmentum stellatum coactum faciens, quod ex catenis longis parallelis cellularum constans, cellulis catenarum cylindraceis, hyalinis, tenuitunicatis, saepe aliquot tumidis et ad septa constrictis, cellulis amplioribus catenarum 12.5-63.5 μm latis per hyphas graciles 3.5-11.0 μm latas, ramosas et anastomoscantes colligatis; fibulae in velo universale et in stipite rarae, plerumque valde irregulares.

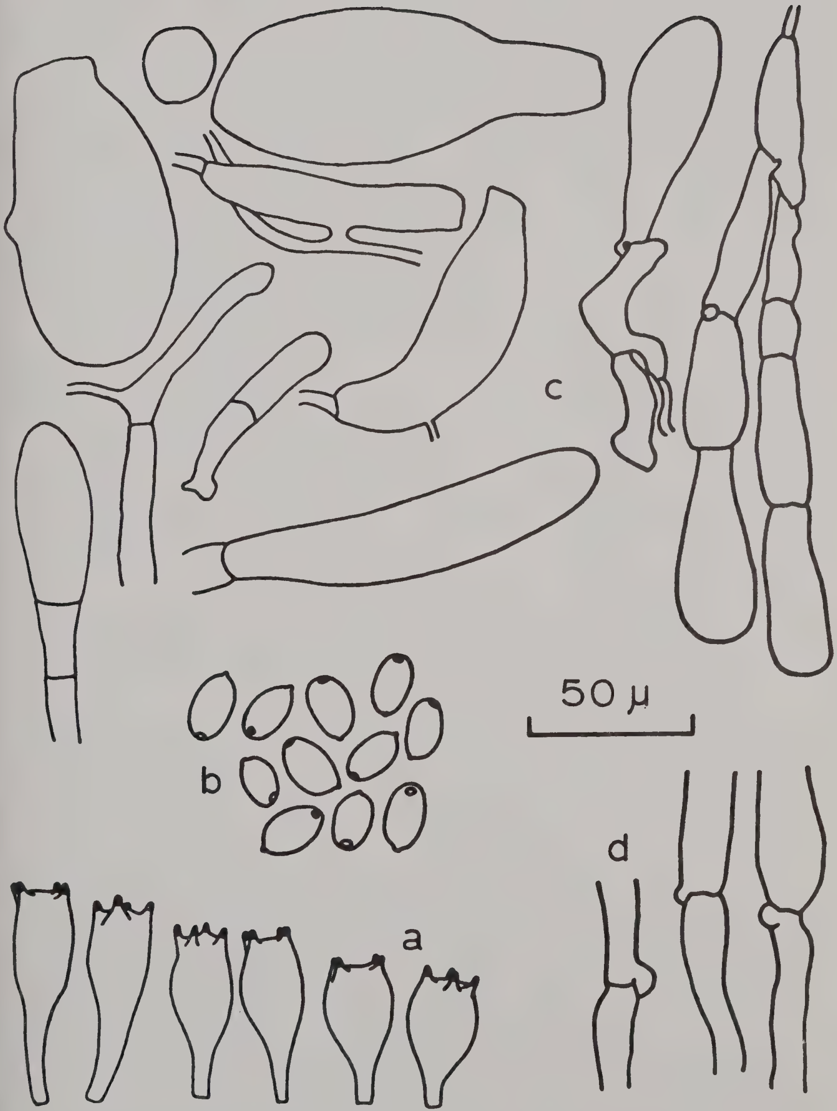

Fig. 5. Coprinus asterophoroides FVDB 3333, a. basidia, b. spores, c. universal veil, d. universal veil clamp connections.

Holotypus FVDB 3333 in solo arenario in deserto, Beverly, comitato Grant, pago Washingtonis, 5 Aug., 1974, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first rounded, then hemispherical, then campanulate, then plane, and finally mostly lysed, when unexpanded 2.0-3.0 cm long, expanding to 4.0-6.0 cm broad. Universal veil white when young, then cuticle darkening to black or blackish brown as universal veil recedes, apex remaining white with universal veil. Universal veil of a felt-like consistency, very thick, soon torn into a distinctly stellate persistent remnant as pileus expands. Pileal surface becoming deeply plicate striate. Pileal margin becoming revolute or curling under and eventually reduced to tattered shreds.

STIPE hollow, slender, 7.0-11.5 cm x 3.0-6.0 mm. Stipe lumen with a distinct and persistent hyphal strand in the center. Surface mostly smooth and glabrous, some appressed fibrils near the bottom or occasionally small scales on the lower half. White at first, then slowly blackening as lysis proceeds, opaque. Flesh very thin and fragile.

LAMELLAE lanceolate, free and remote, very crowded, soot black when mature, autolysis complete.

SPORES ovate to ovate-ellipsoidal, slightly flattened, 17.5-20.0 x 11.2-12.5 μm, apiculus usually small, germ pore apical to very eccentric, 1.8 μm in diameter. Color soot black en masse and a dark brownish purple-black microscopically in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 35.0-39.0 x 20.0-22.5 μm, clavate and 50.0-54.0 x 20.0-22.5 μm, subululiform and 52.0-64.5 x 20.0-21.5 μm, sterigmata with dark somewhat refractive plugs, apex of basidia dark grey-brown, all four-spored.

CYSTIDIA not seen.

PILEAL SURFACE of slender, cylindrical, radially aligned, thin-walled hyphae. Many hyphae with irregular patches of dark brown pigment on the cell walls.

UNIVERSAL VEIL composed of long parallel, radially aligned chains of long, often somewhat swollen cells, constricted at the septae, larger cells of the chains bound together by slender, branched and anastomosed hyphae. All cells of universal veil hyaline and thin walled. Large cells 12.5-63.5 µm in diameter. Cells of the binding hyphae 3.5-11.0 µm in diameter.

CLAMP CONNECTIONS present in universal veil and rarely on the stipe, usually very irregular.

HABITAT terrestrial, on sandy soil in dry open sagebrush desert area.

Observations: This species is closely related to C. asterophorus Long & Miller and to C. xerophilus Van De Bogart. It shares many morphological features as well as the arid habitat with both. C. asterophoroides differs from C. asterophorus in possessing a distinct and persistent hyphal strand in the stipe lumen, the universal veil remaining white even when dried, the germ pore often very eccentric, the much larger diameter of the universal veil elements, the absence of a bulbous volvate stipe base, and the larger and much broader basidia with pigmented apices. C. asterophoroides differs from C. xerophilus in the universal veil remaining stellate, the smaller germ pore, the absence of a bulbous volvate stipe base, and the pigmented apex of the basidia.

Material Examined. Washington: HOLOTYPE, FVDB 3333*, 5 August, 1974; Hosford 1878 (ELRG).

6. Coprinus xerophilus VAN DE BOGART sp. nov. (Fig. 6)

Pileus primo breviter glandiformis vel subglobosus, dein campanulatus, tandem revolutus, apice late tholiformi remanenti, 1.6-4.0 cm latus, primo candidus, ubi velo universali tectus albus remanens, margine atrascenti; pagina pilei leviter plicato-striata vel velo universali crasso coacto albo tecta, velo ex fragmento unico pileato vel fragmentis aliquot irregularis constanti carne tenui et membranacea; stipes albus, cavus, lumine telam subtilam vel filum laneum continenti, gracilis supra fere aequalis, 4.0-7.5 cm longus, 2.5-6.0 mm crassus, basi bulbosa et 6.0-12.0 mm lata, pagina stipitis supra basem crista distincta volvata instructa, carne pro parte maxima

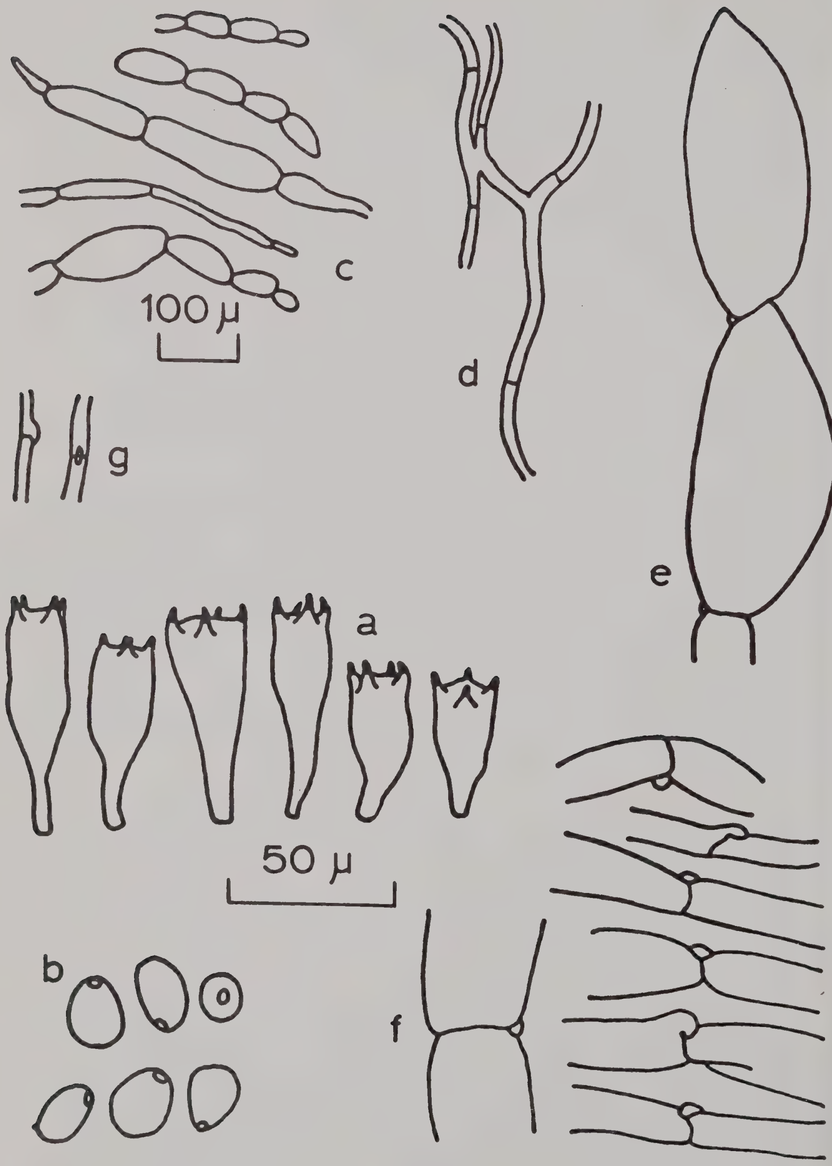

Fig. 6. Coprinus xerophilus FVDB 2159, a. basidia X500, b. spores X500, c. universal veil X125, d. universal veil X500, e. universal veil X500, f. stipe clamp connections X500, g. universal veil clamp connections X500.

crassa et fibrillosa, basi solida; lamellae anguste ovatae vel lanceolatae, liberae et remotae, aggregatae, in maturitate atrae, autolyse tantum partiali.

Sporae laeves, dorsaliter late ovatae, lateraliter ovato-ellipsoideae, aliquantum complanatae, 17.5-22.6 x 11.2-16.3 x 10.6-12.5 µm, poro germinationis excentrico; basidia trimorphica, tetraspora; basidia breviter clavata 38.8-47.5 µm longa, 18.8 µm crassa; basidia longe clavata 50.0-62.5 µm longa, 17.5-18.8 µm crassa; basidia subululiformia 53.8-60.5 µm longa, 17.5-25.0 µm crassa; sterigmata obturamenta granda refractiva vel pigmentifera praebentia; pagina pilei ex hyphis radiantibus constans; velum universale superficiei pilei ex strato crasso coacto constans, strato ex catenis longis cellularum cylindricarum vel oblongarum constanti, cellulis catenarum laevibus, hyalinis, tenuitunicatis hyphis nonnullis tenuioribus insuper adsunt; basis stipitis cristam volvatum cellularum similium praebens; stipes et velum universale fibulata.

Holotypus FVDB 2159 terrestris, in solo arenario vel glareosa locorum aridorum, Nephi, comitato Juab, pago Utah, 15 June, 1957, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS short glandiform to subglobose, then rounded conic, then broadly campanulate and eventually revolute, apex remaining somewhat broadly domelike, upon expansion becoming 1.6 to 4.0 cm broad, white at first and remaining white where covered by the universal veil. Margins eventually becoming black due to spore production and lysis. Surface showing only a small amount of plicate striation where not covered by the universal veil along the margin, mostly covered by a thick, densely interwoven universal veil which may remain in one caplike piece or break up into irregular patches and areolae, the surface under the universal veil usually becoming evident only upon complete pileal expansion and then mostly along the pileal margin. Flesh under the thick universal veil thin and membranous, only becoming about 1.0 mm thick at the apex.

STIPE hollow, stuffed with widely spaced and more or less loose hyphae that sometimes form a fine webbing or a slender yarnlike thread in the center of the lumen, somewhat slender, nearly equal above the distinctly

bulbous base, 4.0-7.5 cm x 2.5-6.0 mm, and the base itself 6.0-12.0 mm in diameter, white and opaque. Bulb of stipe base with a distinct volvate ridge on its upper surface, well separated from the stipe shaft. Flesh fairly thick and fibrous, up to 1.5 mm thick, the base tending to be solid. Surface of base outside of the volva covered with sand grains and debris.

LAMELLAE narrowly ovate to lanceolate, some short lamellulae present, but sometimes few in number, 0.8-2.8 x 1.0-1.2 cm, free and remote to free and close, crowded at first, then somewhat less crowded with the limited development of plicate striation as the pileus expands, pale then black. Autolysis fairly complete, the lamellae all lysing and only the universal veil and part of the pileal surface remaining.

ODOR AND TASTE unknown.

SPORES broadly ovate to somewhat mitriform in dorsal view, ovate-ellipsoidal in lateral view, somewhat flattened, 17.5-22.6 x 11.2-16.3 x 10.6-12.5 µm, apiculus sometimes large and conspicuous, and sometimes small and not conspicuous, germ pore eccentric and broad, 2.5-3.2 µm in diameter. Color en masse soot black, microscopically deep clear brown to deep purplish brown in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 38.8-47.5 x 18.8 µm, long clavate and 50.0-62.5 x 17.5-18.8 µm, subululiform and 53.8-60.5 x 17.5-25.0 µm, all four-spored, sterigmata pigmented or plugged.

CYSTIDIA: Cheilocystidia probably present but all destroyed by lysis of lamellar margin. No other cystidia present.

PILEAL SURFACE a cutis of radially oriented hyphae.

UNIVERSAL VEIL consisting of a thick feltlike portion on the pileus and a distinct volvate rim on the upper part of the bulbous base of the stipe, the pileal universal veil composed of long chains of cylindrical to sausagelike swollen cells that are constricted at the septations. All cells smooth, hyaline, and thin walled, 25.0-195.0 x 3.7-50.5 µm. Some narrow hyphae interwoven among the swollen cells and sometimes anastomosed with them, appearing to bind the larger filaments together. The volval universal veil composed of the same kind of elements but having a larger proportion of the slender nonswollen filaments.

CLAMP CONNECTIONS present on stipe and sometimes on universal veil elements.

HABITAT terrestrial, on sandy or gravelly soil in dry to semiarid areas, solitary or in groups of scattered individuals.

Observations: This species is closely related to two other species, *C. asterophorus* and *C. asterophoroides*. It differs from *C. asterophorus* in its larger flattened spores, much larger basidia, persistent stipe thread, nonasteriform universal veil remnant on the pileus, and white universal veil as opposed to honey yellow to chamois. *C. xerophilus* differs from *C. asterophoroides* in its pileal universal veil of scattered patches, larger germ pore, presence of a bulbous volvate stipe base, and lack of a pigmented apex of the basidia. These species bear a striking superficial resemblance to the gasteroid genus *Montagnea*.

Material Examined. Washington: FVDB 2155. Utah: HOLOTYPE, FVDB 2159*, 15 June, 1957.

7. *Coprinus umbrinus* Cke. and Massee, Grevillea 21:41, 1892: sensu Rea, Brit. Basid., p. 500, 1922. (Fig. 7)

PILEUS at first glandiform. Pale creamy yellowish to umber at apex at first, becoming dark grey with an umber apex. Surface at first covered with small scales but by maturity only the apex remaining covered with a small loose cap of scales.

STIPE hollow, with a loose web of hyphae and a yarnlike hyphal cord in the upper half. Slender, slightly tapered from base to apex, 6.0-7.8 cm x 2.0-4.0 mm. Mostly white to dingy white, base pale umber, opaque. Prominent, loose, flaring, submembranous annulus present and appearing to be a volva margin dislodged from the stipe base and carried a short distance up the stipe as it

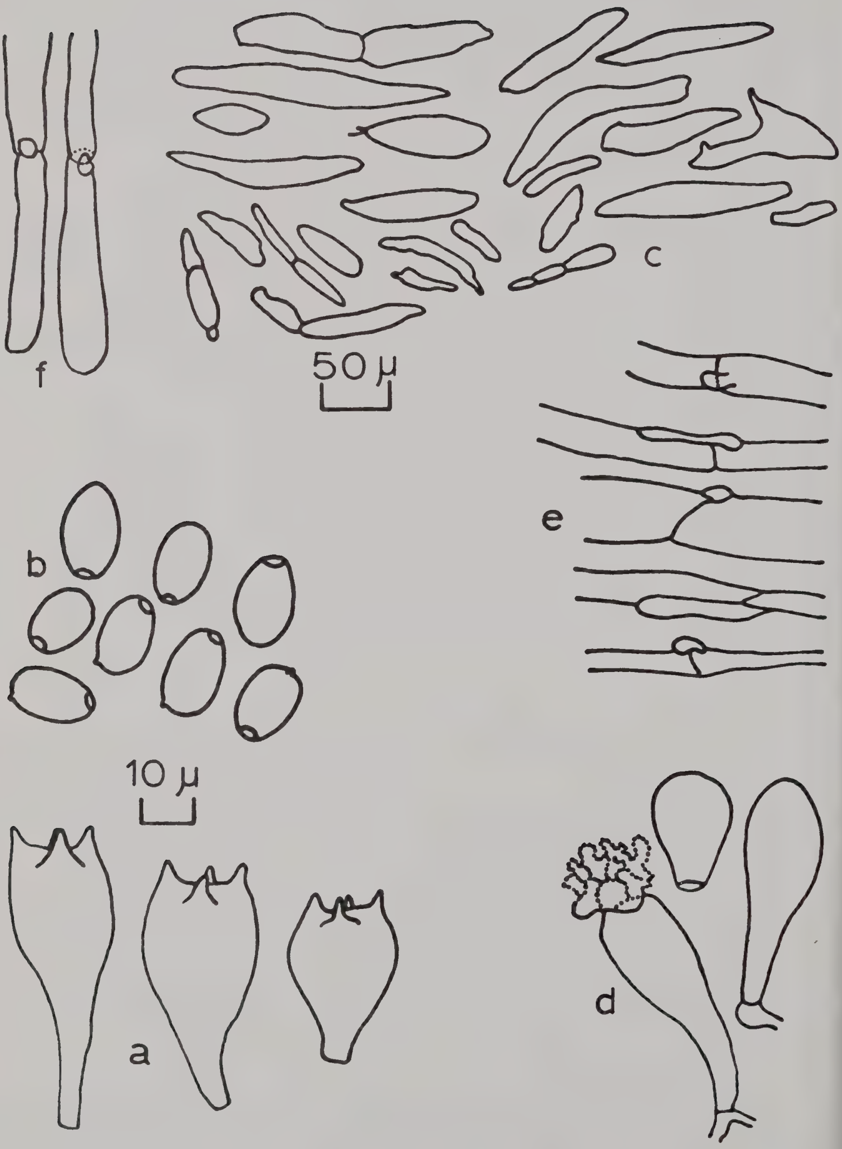

Fig. 7. Coprinus umbrinus FVDB 207, a. basidia X1000, b. spores X1000, c. universal veil X250, d. cheilocystidia X1000, e. stipe clamp connections X1000, f. universal veil clamp connections X1000.

elongates. Some loose bits and patches of white woolly tomentum below the annulus. Flesh somewhat fibrous but very fragile.

LAMELLAE narrow, linear, mostly long, few short lamellae present, 11.0 x 2.5 mm. Autolysis complete.

ODOR AND TASTE indistinct.

SPORES ovate-elliptic in both dorsal and lateral views, slightly flattened, (14.0-)16.0-17.0(-18.0) x 10.0-11.0 x 9.0-9.5 µm, apiculus large and conspicuous, germ pore eccentric, 2.0-2.5 µm in diameter. Color microscopically smoky brown in 3% KOH, appearing to contain many tiny dark granular inclusions. Wall smooth.

BASIDIA trimorphic, short clavate and 28.5-30.0 x 22.0 µm, long clavate and 44.0-47.5 x 18.5-22.0 µm, long pedicellate-clavate and 55.0-56.5 x 19.5-20.5 µm, all four-spored.

CYSTIDIA: Cheilocystidia subglobose, pyriform or clavate, 15.0-45.0 x 13.0-17.5 µm, smooth, hyaline or with an amorphous content that stains in 1% aqueous Congo Red. No other cystidia present.

PILEAL SURFACE of radially oriented hyphae.

UNIVERSAL VEIL elements consisting of large swollen sausage-shaped cells and ordinary cylindrical septate hyphae, the swollen cells tending to form parallel chains that are constricted at the septations. Cell size variable, 30.0-350.0 x 2.0-30.5 µm. All cells hyaline, smooth, and thin walled.

CLAMP CONNECTIONS present in stipe and rarely on pileal veil.

HABITAT coprophilous, on horse dung in open grassy pasture, solitary.

Observations: My collection of this species differs from that described by Rea only in the volva being torn loose so that it becomes an annulus, and in the more pallid coloring of the sporocarp.

Material Examined. Washington: FVDB 207*.

8. Coprinus roseistipitatus VAN DE BOGART sp. nov. (Fig. 8)

Pileus primo glandiformis, dein conicus, postremo campanulatus, marginibus aliquantum revolutis et laciniatis, primo 2.5 cm longus, post expansionem 3.5 cm latus, primo pallide brunneus et color ille ad apicem remaneus, dein sordidialbus, postremo ater cum striis albidis, pagina pilei velo universali primo intacto et ad instar membranae rasilis, dein in squamis rumpenti, squamis postremo dispersis et evanescentibus, pagina hoc modo exposita plicato-striata, carne tenui et fragili; stipes gracilis, apicem versus gradatim angustatus, 11.5 cm longus, 4.0-7.5 mm crassus, cavus, telam hypharum laxis capiens, pagina stipitis sericea, rugosa, basi alba, dimidio apicali in maturitate pallide subroseigrisescenti; annulus prominens, laxus, in maturitate in pagina infera atrescens; caro stipitis tenuis et fragilis etsi fibrosa; lamellae lanceolatae, confertae, liberae et remotae, primo albae, postea roseibrunneae pallidae, postremo atrae, autolyse completo.

Sporae fere ovatae, apice dorsaliter viso leviter angustato, 9.0-11.0 x 5.5-6.5 x 7.0-7.8 µm, poro germinationis leviter excentrico, in cumulo atrae, per microscopicum fere atrae; basidia trimorphica, tetraspora; basidia clavata 25.0-28.0 µm longa, 8.0-11.5 µm crassa; basidia longe clavata 40.0-43.5 µm longa, 8.0-10.0 µm crassa; basidia ululiformia 48.0-50.0 µm longa, 9.0-10.0 µm crassa; sterigmata obturamenta refractiva habentia; basidia zonam griseam in medio habentia; cheilocystidia obovata, oblonga, clavata, subglobosa, interdum conjuncta, pro parte maxima pedicellata, 30.0-70.0 µm longa, 17.0-33.0 µm crassa, pedicellis usque ad 20.0 µm longis, cheilocystidiis in cumulo distincte roseis; pagina pilei ex hyphis radiantibus constans, in maturitate cellulis hypharum pro parte maxima atrogriseibrunneis; velum universale superficiei pilei ex squamis constans, velo ad basem stipitis ex tomento constans, squamis ex catenis parallelis cellularum constantes, cellulis catenarum cylindracea laevis, leviter tumidis, tenuitunicatis hyalinis, 5.0-22.0 µm latis, raro ramificantibus, aliquando ad septum secedentibus; tomentum ad basem stipitis tenuissimum, ex hyphis gracilibus tenuitunicatis haud tumidis constans, cellulis hypharum raro ramosis sed abundanter intertextis, 3.0-6.0 µm latis, septis sparsis; annulus 1.0 mm latus; fibulae desunt.

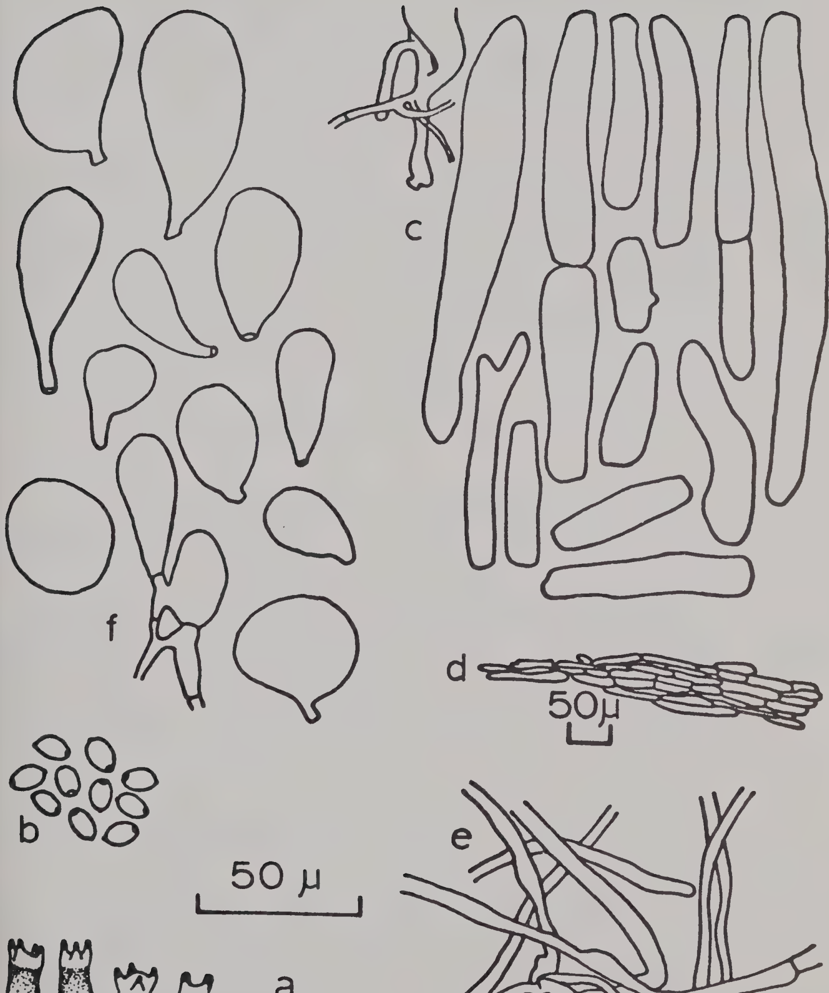

Fig. 8. Coprinus roseistipitatus FVDB 3369, a. basidia X500, b. spores X500, c. pileal universal veil X500, d. parallel chains of pileal universal veil X125, e. stipe base universal veil tomentum X500, f. cheilocystidia X500.

Holotypus FVDB 3369, in stercore cuniculorum vel cervorum, substratum mycelio albo coacto persistenti obtectum, Cispus Center, Gifford Pinchot National Forest, comitato Lewis, pago Washingtonis, 25 Oct., 1975 in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS at first glandiform, then conic, then campanulate with margins somewhat revolute and laciniate, when unexpanded 2.5 cm in length, expanding to 3.5 cm in width. Pale brown at first and remaining so at the apex, the remainder soon whitish, then black with whitish striae marking the interlamellar spaces. Pileal surface at first covered with smooth universal veil which then becomes scaly, then scales scattered and evanescent exposing a plicate-striate surface. Margin attached to stipe by an annulus at first. Flesh thin and fragile.

STIPE slender, tapering gradually toward the apex, 11.5 cm x 4.0-6.5 mm, hollow, lumen with a thinly dispersed webbing of hyphae, surface silky, wrinkled, white at base, in maturity the upper half of the stipe becoming pale pinkish grey, fading to grey when dried, annulus prominent, loose, becoming black on under surface when mature; stipe flesh thin and fragile although fibrous.

LAMELLAE lanceolate, very crowded, free and remote, at first white, then pale pinkish brown, then soot black. Autolysis complete.

SPORES nearly ovate, the apex slightly narrowed in dorsal view, 9.0-11.0 x 5.5-6.5 x 7.0-7.8 μm, apiculus large and distinct, germ pore somewhat eccentric, 1.5-2.5 μm in diameter. Color soot black en masse and nearly black microscopically in 3% KOH. Wall smooth.

BASIDIA trimorphic, clavate and 25.0-28.0 x 8.0-11.5 μm, long clavate and 40.0-43.5 x 8.0-10.0 μm, ululiform and 48.0-50.0 x 9.0-10.0 μm, all four-spored, all sterigmata with refringent plugs, all basidia with a median grey pigment band.

CYSTIDIA: Cheilocystidia obovate, oblong, clavate, subglobose, occasionally interconnected, mostly pedicellate, 30.0-70.0 x 17.0-33.0 μm, pedicels up to 20 μm in length, cells distinctly pink en masse until destroyed by lysis. No other cystidia present.

PILEAL SURFACE a compact layer of cylindrical, septate, thin-walled, radially oriented hyphae, in maturity mostly pigmented dark grey-brown, some cells dark, some light, some pigment in the walls, some pigment in the intercellular spaces.

UNIVERSAL VEIL of scales on pileus and tomentum at stipe base. Scales of long parallel chains of slightly swollen cells, cells cylindrical, 5.0-22.0 µm in diameter, thin-walled, hyaline, rarely branching, showing some tendency to separate at the septa, smooth. Tomentum at stipe base very thin, composed of slender, cylindrical, hyaline, thin-walled hyphae, seldom branched, very interwoven, 3.0-6.0 µm in diameter, septation sparse. Annulus 1.0 mm wide.

CLAMP CONNECTIONS absent.

HABITAT coprophilous, on rabbit or deer dung in a very moist hardwood rain forest. Substrate covered with a thin but persistent white feltlike mycelium.

Observations: This species somewhat resembles C. sterquilinus but differs in the brown color of the universal veil when young, the much smaller spores, the pink color of the stipe apex, the pink cheilocystidia, the blackening of the undersurface of the annulus, and the median grey band on each basidium.

Material Examined. Washington: HOLOTYPE, FVDB 3369*, 25 October, 1975.

9. Coprinus colosseus VAN DE BOGART sp. nov. (Fig. 9)

Pileus primo oblongo-ovalis, dein late campanulatus, postremo laciniatus et revolutus, 13.0-25.4 cm longus, 8.0-14.0 cm latus, primo albus, squamis apicibus brunneis et apice pallide brunneo, in maturitate ater, aliquantum plicato-striatus; pagina pilei velo universali tecta; velum squamas parvas, albas vel apicibus brunneis praebens, primo ad pileum firme affixum, in maturitate tantum laxe affixum, carne pro parte maxima tenui et membranacea; stipes cavus, lumine filum tenuem hypharum intertextarum continenti, fere aequalis, 35.0-50.5 cm longus, 1.5-2.5 cm crassus, basi abrupta, usque ad 8 cm

in solo inclusa, plerumque annulo parvo laxo munitus, primo omnino albus, dein in maturitate carne apicali tarde denigricanti, pagina stipitis laevis et glabra, carne grossa et fibrosa; lamellae lineares liberae sed ad collarium parvium affixae, confertissimae, in maturitate ater, autolyse fere completo.

Sporae laeves, aliquantum complanatae, dorsaliter visae ovatae, lateraliter visae ovato-ellipsoideae, 16.8-20.0 x 9.8-13.7 x 8.4-11.3 µm, contento minute guttulato, poro germinationis excentrico; basidia trimorphica, tetraspora; basidia breviter clavata 31.5-35.5 µm longa, 16.0-18.0 µm crassa; basidia longe clavata 42.5-48.5 µm longa, 17.0-18.0 µm crassa; basidia longissime clavato-pedicellata 54.0-65.0 µm longa, 19.0-20.0 µm crassa; sterigmata obturamentum amplum refractivum vel pigmentiferum praebentia; cheilocystidia globosa vel ellipsoido-ovata, 20.0 µm usque ad 35.0-50.0 µm longa, 20.0-25.0 µm crassa, hyalina, laevia; pagina pilei ex hyphis radiantibus constans; velum universale superficiei pilei ex squamis constans, hyphis squamarum cylindraceis, septatis, pro parte maxima aliquantum tumidis et catenulatis velum universale; basis stipitis tomento tenui hypharum tenuium non tumidarum ramosarum et intertextarum praedita, cellulis tomenti omnes laevibus, hyalinis, tenuitunicatis; rhizomorphae usque ad 15.0 cm longae ex hyphis compactis albis constans; fibulae in stipite rarae.

Holotypus FVDB 143 terrestris, Redmond, comitato King, pago Washingtonis, 20 May, 1966, in herbario Universitatis Washingtonis conservatus (WTU).

PILEUS oblong-oval at first, then narrow conical, then narrow campanulate, then broadly shallow campanulate, and eventually laciniate-revolute. Prior to expansion 13.0-25.4 cm in length and after expansion 8.0-14.0 cm broad, the smaller size due to autodigestion during expansion. White with brownish-tipped scales and pale brown pileal apex at first and then gradually darkening with maturity and autolysis. Plicate striation limited in development, involving little or none of the lamellar trama. Surface covered with a universal veil of rather small scales that are white to white with brownish tips. Scales firmly attached when pileus is immature but becoming loose and easily removable as pileus matures. Flesh mostly thin and membranous but up to 3.0 mm in thickness at apex.

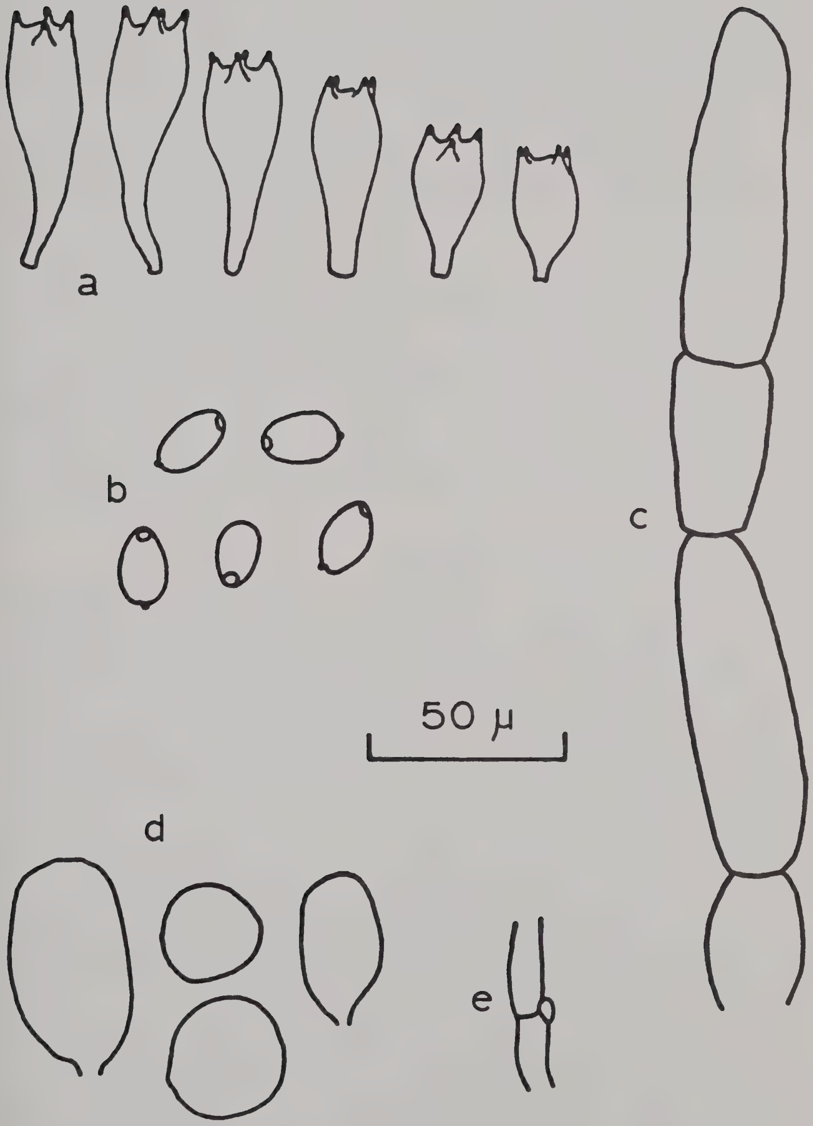

Fig. 9. Coprinus colosseus FVDB 143, a. basidia, b. spores, c. universal veil, d. cheilocystidia, e. stipe clamp connection.

STIPE hollow, the lumen containing a loose yarnlike thread of loosely interwoven filaments. Almost equal but with a slight tapering from base to apex, 35.0-50.5 cm x 1.5-2.5 cm , the base abrupt and embedded up to 8 additional centimeters into the soil. A small loose annulus present on some specimens. Surface seeming smooth and glabrous. White at first, then as spores are produced and autolysis proceeds the apical flesh slowly blackening internally as well as externally. Flesh opaque, coarse and fibrous.

RHIZOMORPHS of compact white hyphae penetrating about 15.0 cm into the substrate from some specimens.

LAMELLAE linear, almost all long, 8.0-25.0 x 1.5-2.3 cm, free but attached to a small collarium. Extremely crowded at first and remaining crowded throughout sporulation and lysis, pale but becoming soot black. Autolysis almost complete, nearly the entire pileus affected.

ODOR AND TASTE none.

SPORES ovate in dorsal view and ovate-ellipsoidal in lateral view, somewhat flattened, 16.8-20.0 x 9.8-13.7 x 8.4-11.3 μm, apiculus large and conspicuous, germ pore somewhat eccentric to very eccentric, 1.8-3.1 μm in diameter. Color en masse soot black, microscopically an extremely dark smoky black color in 3% KOH. Contents seeming minutely guttulate or granular in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 31.5-35.5 x 16.0-18.0 μm, long clavate and 42.5-48.5 x 17.0-18.0 μm, very long clavate-pedicellate and 54.0-65.0 x 19.0-20.0 μm, all four-spored, all sterigmata with a large refractive or pigmented plug.

CYSTIDIA: Cheilocystidia globose or ellipsoidal-ovate, globose 20.0-37.5 μm in diameter, ellipsoidal-ovate 35.0-50.0 x 20.0-25.0 μm, hyaline, smooth. No other cystidia present.

PILEAL SURFACE of radially oriented hyphae.

UNIVERSAL VEIL scales composed of cylindrical septate hyphae, mostly swollen and somewhat constricted at the septations, smooth, hyaline, thin-walled cells 17.5-165.0 x 5.0-38.0 µm. A thin tomentum present at base of stipe, composed of slender, nonswollen, hyaline, smooth, thin-walled, branched and interwoven septate hyphae, the cells tending to be long and straight.

CLAMP CONNECTIONS rare on stipe cuticle.

HABITAT terrestrial, on loose, crumbly soil in a dense brushy scrub frondose forest, in large loose clumps, rare.

Observations: This species is well marked by its huge overall size, large spore size, and by the darkening of the stipe apex. The last two features it shares with C. sterquilinus, a coprophilous species which is much smaller.

Material Examined. Washington: HOLOTYPE, FVDB 143*, 20 May, 1966.

10. Coprinus comatus var. comatus (Fig. 10)

PILEUS ovate-oblong at first, then conic, then campanulate, and eventually revolute or laciniate or both. Prior to expansion 6.4-12.0 cm in length and after expansion 3.5-10.0 cm in breadth. White ground color with brown-tipped scales and all brown at the apex, eventually most of the pileus slowly blackening and the brownish scales and apex becoming dark brown with age. Numerous shallow plicate striations developing beneath the thick white universal veil and only becoming apparent when the pileus expands enough to dislodge some of the veil from the pileal margin area, the striations involving little or no splitting of the lamellar trama. Universal veil thick, smooth at the pileal apex, the remainder squarrosely scaly, the fibrillose scales 2.0-9.0 mm long and wide. The veil covering the pileal surface entirely until late maturity when small portions of the surface are revealed by splitting, dislodgment, or lysis of the veil elements. Flesh thin and membranous except at the apex where it may reach up to 2.0 mm thick.

STIPE hollow, the lumen containing a loosely interwoven yarnlike hyphal thread in its center, base bulbous to abrupt, tapering to a narrower apex 7.5-19.0(-32.0) cm

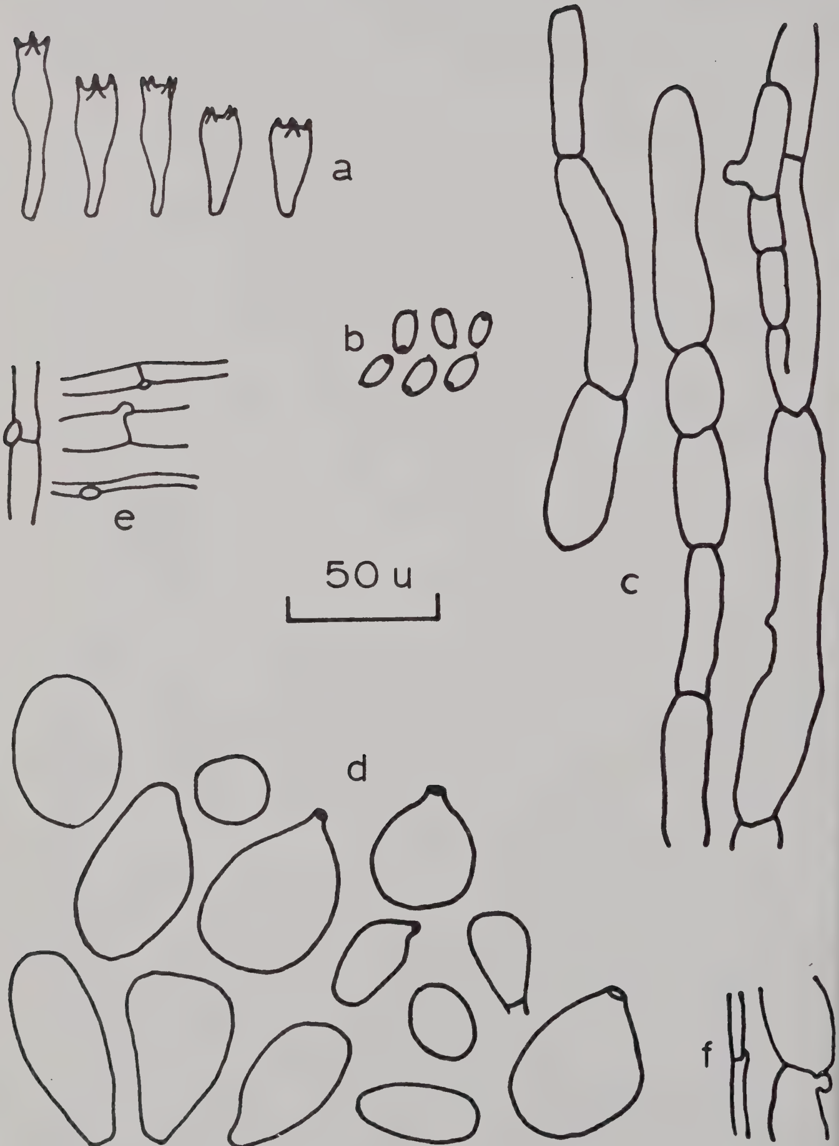

Fig. 10. Coprinus comatus var. comatus FVDB 2140, a. basidia, b. spores, c. universal veil, d. cheilocystidia, e. stipe clamp connections, f. universal veil clamp connections.

x 3.5-21.0 mm. White and opaque. Surface smooth, silky-glabrous. Flesh fibrous but somewhat brittle, up to 2.0 mm thick. Large loose white annulus present, usually near the stipe base, which seems to be the edge of a fragile volva that is almost always attached more firmly to the pileal margin than to the stipe base and hence carried part way up the stipe upon expansion.

LAMELLAE linear, lamellulae few or none, 4.0-11.8 x 1.0-1.2 cm, free and remote, crowded and remaining so throughout the spore discharge period, white, then rose pink, then purple to grey-black, and finally soot black. Autolysis complete.

ODOR AND TASTE; faint odor of mushrooms, taste mild.

SPORES mostly ellipsoidal and round in cross section, some broadly ellipsoidal, 10.6-13.8(-17.6) x 5.5-7.6 (-10.0) μm, apiculus usually large and prominent but sometimes small, germ pore apical, 1.8-3.0 μm in diameter. Color en masse soot black, microscopically medium to deep brown or smoky brown or smoky grey-brown in 3% KOH. Contents guttulate or not, often with a finely granular appearance in 3% KOH. Wall smooth.

BASIDIA trimorphic, short clavate and 23.8-33.0 x 11.5-15.0 μm, long clavate and 35.0-46.5 x 9.0-16.2 μm, subululiform to ululiform and 45.0-67.5 x 11.3-17.5 μm, all four-spored, the sterigmata with conspicuous dark, refringent plugs inside them.

CYSTIDIA: Cheilocystidia globose, ovate, clavate, and short ellipsoidal, often with one or more types lacking, globose 13.9-35.0 μm in diameter, ovate 25.0-50.0 x 19.0-25.0 μm, clavate to ellipsoidal 25.0-50.0 x 13.9-28.0 μm, hyaline, smooth, a few with a short pedicel 1.0-3.0 μm long. No other cystidia present.

PILEAL SURFACE of radially oriented hyphae.

UNIVERSAL VEIL composed of slender, nonswollen, septate, hyaline to pale yellowish, somewhat branched and anastomosed, thin-walled, smooth hyphae and of long chains of hyaline, thin-walled, unbranched, nonanastomosed, smooth, swollen hyphae with sausage-shaped cells and with constriction at the septa. Nonswollen cells

1.5-5.5 µm in diameter. Swollen cells 5.5-33.5 µm in diameter. The macroscopically brown veil from the pileal apex is yellow-brown in 3% KOH microscopically.

CLAMP CONNECTIONS almost always present on some universal veil hyphae and often present on stipe hyphae, but rarely present on pileal surface hyphae.

HABITAT terrestrial, on lawns, by roadsides, along trails, near compost heaps, and occasionally in forested areas, always on soil, solitary to clumped or even densely caespitose.

Observations: *Coprinus comatus* is a good example of a species possessing a pileal universal veil which is at first very adherent and which cannot be removed but which becomes progressively looser until it can be easily wiped off of the pileal surface. Variety *comatus* is based on information given in two modern European handbooks that include some microscopical information. According to Marchand (1971, p. 54 and 225) and Romagnesi (1961, p. 21, fig. 48) typical spores of *C. comatus* have an apical germ pore, hence the use of that feature here.

Material Examined. Washington: FVDB 180, 236, 254. 1188, 1728, 1730, 1744, 1880, 2136, 2140*. Utah: 1789. Arizona: 1800.

11. *Coprinus comatus* var. *parvus* VAN DE BOGART var. nov. (Fig. 11)

A typo differt sterigmatabus hyalinis obturamentis refractivis destitutis, amplitudine parva sporocarpii, pileo 4.0-5.0 cm longo, stipite in maturitate 5.0-6.0 cm longo.

Holotypus FVDB 225 in solo, Burton, comitato King, pago Washingtonis, 18 Sept., in herbario Universitatis Washingtonis conservatus (WTU).

As described in variety *comatus* except the sterigmata of the basidia are hyaline and lack the refractile plug, and the sporocarps are of small size, the pileus 4.0-5.0 cm long prior to expansion and the stipe 5.0-6.0 cm long at maturity.

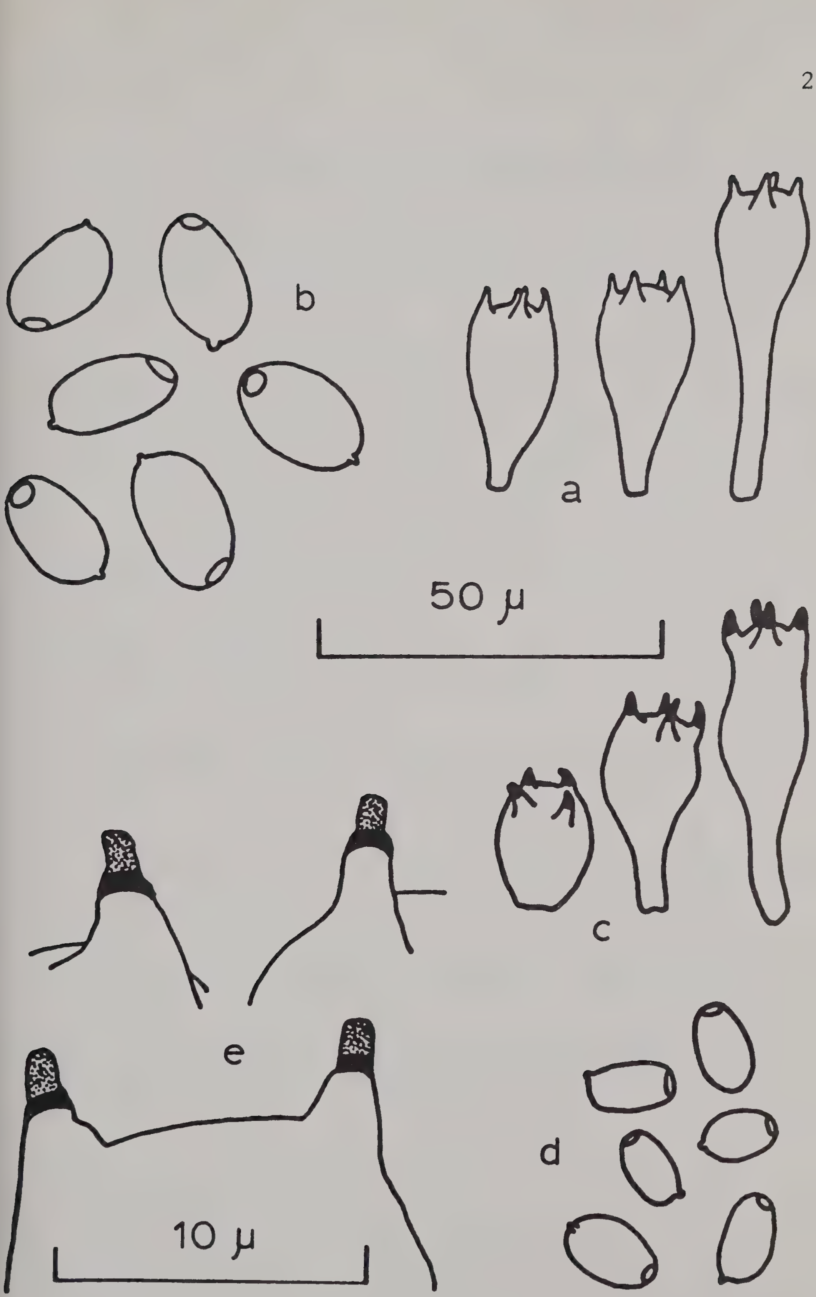

Fig. 11. Coprinus comatus var. parvus FVDB 225, a. basidia X500; var. excentricus FVDB 1801, b. spores X500; var. caprimammillatus FVDB 2141, c. basidia X500, d. spores X500, e. sterigmata X2500.

Material Examined Washington: HOLOTYPE, FVDB 225*, 18 September, 1971; FVDB 2139.

12. Coprinus comatus var. excentricus VAN DE BOGART var. nov. (Fig. 11)

A typo differt sporis pergrandibus, 14.0-18.0 μm longis, porum germinationis excentricissimum praebens.

Holotypus FVDB 1801 in solo, comitato Coconino, pago Arizonae septentrionalis, 18 Aug., 1973 in herbario Universitatis Washingtonis conservatus (WTU).

As described in variety comatus except the germ pore is very eccentric and the spores are usually large.

Material Examined. Arizona: HOLOTYPE, FVDB 1801*, 18 August, 1973. Washington: FVDB 2138.

13. Coprinus comatus var. caprimammillatus VAN DE BOGART var. nov. (Fig. 11)

A typo differt sporis sporocarpium omnium porum germinationis apicalem excentricumque praebentibus.

Holotypus FVDB 2141 in solo, comitato Pierce, pago Washingtonis, 14 Sept., 1956, in herbario Universitatis Washingtonis conservatus (WTU).

As described in variety comatus except that each sporocarp has some spores with an apical germ pore and some spores with the germ pore at least somewhat eccentric.

Observations: Marchand (1971) and Romagnesi (1961) indicate that the spores of the typical C. comatus have an apical germ pore, presumably invariably and indeed some of my collections (var. comatus) have all spores with an apical germ pore. Therefore, var. caprimammillatus is presented as a separate taxon of varietal rank.

Material Examined. Washington: FVDB 5, 19, 30, 50, 52, 55, 56, 64, 67, 129, 229, 1941; HOLOTYPE, FVDB 2141*, 14 September, 1956; FVDB 2181, 2188. Montana: FVDB 1837.

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MYCOTAXON

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A NEW SPECIES OF TETRACOCCOSPORIUM

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SUMMARY

Tetracoccosporium aerium Misra & P. Srivastava, a new species isolated from air, Gorakhpur, U.P., India, is described and illustrated.

Tetracoccosporium paxianum Szabó, the type species of *Tetracoccosporium* Szabó, is characterized by solitary, cruciately septate conidia developed from integrated, terminal, holoblastic conidiogenous cells of acroauxic, loosely branched conidiophores (Ellis, *1971*). A fungus undoubtedly congeneric with *T. paxianum* was isolated by the authors in September, 1975. It appeared in a petri dish containing malt extract agar medium (Blakeslee, *1915*) and exposed to air at the first floor of the Department of Botany, University of Gorakhpur. The fungus was readily obtained in pure culture. It grew well and sporulated profusely on malt extract agar medium and is considered to be a new species. It differs from *T. paxianum* in having smaller and relatively smooth conidia. Three other species of *Tetracoccosporium* have been described: *T. quadratum* (Cooke) Wiltshire differs from both *T. paxianum* and the present isolate in having larger conidia which are deeply constricted at the septa; *T. sacchari* Stevenson has been shown to be *Dictyoarthrinium sacchari* (Stevenson) Damon, and *T. cupulatum* Rao & Rao appears to have a conidiophore unlike that described for the type species.

Tetracoccosporium aerium Misra & P. Srivastava, sp. nov.
(Fig. 1)

Coloniae in agaro cum extracto maltoso composito cultae anguste crescentes, die undecima sub calore 25-27° C 0.5-1.0 cm diametro, obscure griseo-brunneae. Mycelium ex hyphis

sparse ramosis, septatis, subhyalinis, 1-2 μ crassis compositum. Conidiophori semi-macronemati, laxe ramosi, pallide brunnei, leves; rare plerumque 5-30 μ longi, 1.5-3.0 μ crassi, vulgo prope apicem septo divisi. Conidia singula, acrogena, applanata, in plena facie quadrata, angulis rotundatis, e latere late ellipsoidea, quadricellularia, cruciatim septata, ad septa constricta, fuscobrunnea, minute verruculosa, 8-12 × 6-8 μ.

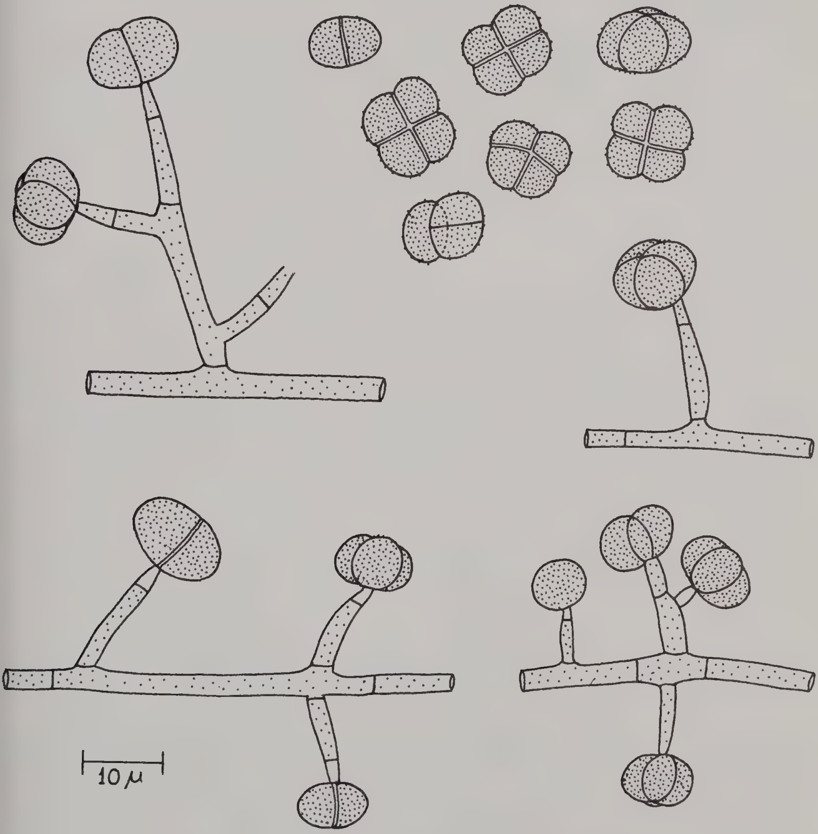

FIG. 1. *Tetracoccosporium aerium.*
Conidia and conidiophores, from type.

Colonies on malt extract agar growing restrictedly, about 0.5-1.0 cm in diam in 10 days at 25-27° C, dark greyish brown. Mycelium consisting of sparsely branched, septate, subhyaline, 1-2 μ thick hyphae. Conidiophores semi-macronematous, loosely branched, light brown, smooth; branches usually

at acute angles to the stipe or one another, occasionally at right angles, usually tapered, 5-30 μ long, 1.5-3.0 μ in diam, usually 1-septate, with the septum placed near the apex. Conidia colitary, acrogenous, flattened in one plane, square rounded at corners in face view, broadly ellipsoidal in side view, divided cruciately by septa at right angles to one another, constricted at the septa, 4-celled, dark brown, minutely verruculose, 8-12 μ in diam in face view, 6-8 μ thick. In old cultures, larger conidia with more than 4 cells were occasionally seen.

Type: PCM 554, isolated from air, Gorakhpur, U. P., India, September, 1975. A dried culture of the type has been deposited in the Commonwealth Mycological Institute, Kew, as IMI 197434. A subculture of the type culture will be sent to the American Type Culture Collection, Maryland, U.S.A.

ACKNOWLEDGEMENTS

We thank Dr. M. B. Ellis for confirmation of the identification and critical review of the maniscript. We are also grateful to Dr. Donald P. Rogers for the Latin diagnosis. The financial assistance of the U.G.C., India, is gratefully acknowledged.

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MYCOTAXON

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TYPE SPECIMENS OF HYPOGEOUS FUNGI IN THE HERBARIUM OF THE NEW YORK BOTANICAL GARDEN

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SUMMARY

Locating type specimens is frequently a prime difficulty in taxonomic research that involves collections older than 50 or more years. All too often, letters of inquiry have to be directed to several likely herbaria in hopes that one of them may have a type or types of interest. During a 3 month research visit to NY, funded by a Burlingham Fellowship from the Garden, we took the opportunity to examine and compile a list of types of hypogeous fungi, which are filed in the general collection. The list was intended for our own use but after several associates expressed interest, we decided it is of general interest and would encourage publication of similar lists for other herbaria.

The following list was compiled by recording label information from all packets labeled "type" and filed in the Tuberales, Hymenogastrales, and Gautieriales. The label information has been annotated with the amount of material present, reference of original type description, synonymy, and an indication (where possible) of the deposition of a designated holotype collection and the possible status of the NY "type" collection. Many of the NY "types" are probably isotypes of Gilkey types at OSC, Harkness or Lloyd at BPI, Thaxter at FH, Massee at K, and Rodway at K or H. The list follows NY's filing system and uses Zeller's (1949) families for the Basidiomycetes and Gilkey's (1954a) treatment for the Ascomycetes.

TUBERALES

Geneaceae

Genabea tasmanica Massee & Rodway in Massee, Kew Bull. Inf. 1898: 125. 1898. Tasmania. Rodway 119. Isotype. One slice. Holotype at HO. *Nomina confusa*. Parasitized by *Microthecium geoporae* (Obermeyer) von Höhnel with no spores of host present (Gilkey 1954b).

Petchiomyces kraspedostoma Gilkey, Oreg. St. Monogr. Bot. 1: 15. 1939. Guadaloupe Mines, California. Coll. H. E. Parks 1051. Det. H. M. Gilkey 42. Two sporocarps plus pieces. Isotype. Holotype in OSC.

Terfeziaceae

Leucangium readeri Cooke & Massee, in clay soil, Victoria, (Dimboola) Reader. *Nomen nudum?* One sporocarp.

Terfezia longii Gilkey, Mycologia 39: 448. 1947. Near Corona, New Mexico, September 17, 1941. Coll. W. H. Long and D. J. Stouffer. Fragments. Isotype in OSC.

Terfezia spinosa Harkn., Proc. Calif. Acad. Sci. III. 1: 277. 1899. In red sand, banks of Red River, Natchitoches, Louisiana, September 1886. Coll. A. B. Langlois 704. Det. J. B. Ellis (?) as *T. leonis*. Abundant collection. Isotype. Holotype in BPI.

Tuberaceae

Choiromyces compactus Gilkey, Oreg. St. Monogr. Bot. 1: 34. 1939. Guadaloupe Mines, California, April 16, 1921. Coll. H. E. Parks 1054. 1 half sporocarp. Isotype. Holotype in OSC.
≡ *Hydnotryopsis compacta* (Gilkey) Trappe, Mycotaxon 2: 116. 1975.

Tuber indicum Cooke & Massee, Grevillea 20: 67. 1892. G. Massee Herbarium, Himalayas. From Kew. One sporocarp plus one half sporocarp. Isotype. Holotype in K.

HYMENOGASTRALES

Gasterellaceae

Gasterella lutophila Zeller & Walker. Mycologia 27: 578-579. 1935. On mud in the greenhouse, University of Nebraska, Lincoln, Nebraska, January 1935. Coll. Leva B. Walker. One sporocarp. Syntype.

Gasterellopsis silvicola Routien, Mycologia 32: 165-166. 1940. 1st. st., College Woods, East Lansing, Michigan, 14 November 1938. Coll. J. B. Routien 9. Isotype. Preserved in FAA.

Melanogastraceae

Alpova cinnamomeus Dodge, Ann. Mo. Bot. Gard. 18: 461. 1931. Half buried in soil beside stream (Siskowit Outlet), Siskowit Bay, 4 September 1930. Coll. A. H. Povah Fp 635. Labelled Syntype but is a Paratype since Holotype is Fp 73 in MICH. Four pieces. ≡ *Alpova diplophloeus* f. *diplophloeus* (Zeller & Dodge) Trappe & Smith in Trappe, Nova Hedwigia Beih. 51: 286. 1975.

Cremeogaster levisporus Mattirolo in Lloyd, Mycol. Writ. 7: 1278. 1924. San Antonio Mountains, Southern California. Coll. Dr. I. M. Johnston, det. O. Mattirolo. Two halves. Isotype. ≡ *Leucogaster rotundisporus* (Matt.) Fogel & Trappe in Trappe, Nova Hedwigia Beih. 51: 306. 1975.

Leucogaster anomalus (Peck) Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 399-400. 1924. In ground in woods, Rock Creek Park, Washington, D. C., September 1906. Coll. T. E. Wilcox. Two halves. Isotype of *Hymenogaster anomalus* Peck, N. Y. State Mus. Bull. 116: 31-32. 1907.

Leucogaster araneosus Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 399. 1924. Cranberry, North Carolina, August 1896. Coll. R. Thaxter 96. Fragments. Isotype. Holotype in FH.

Leucogaster columellatus Zeller, Mycologia 39: 289. 1947. Hypogeous under *Pinus ponderosa*, "Rim of the World," northeast of San Bernardino, San Bernardino County, California, May 1923. Coll. N. L. Gardner 581. Two halves. Holotype. Isotype in UC.

Leucogaster fulvimaculosus Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 401. 1924. In damp woods, Cold Spring Harbor, Long Island, New York. Coll. A. F. Blakeslee. Fragment. Isotype. Holotype in FH.

Leucogaster levisporus Zeller, Mycologia 33: 206. 1941. Hat Point near Imnaha, Wallowa County, Oregon, 26 July 1939. Coll. A. M. Rogers. Abundant collection. Holotype.

Leucogaster longisterigmatus Zeller, Mycologia 39: 289-290. 1947. Under coniferous duff on Monument Peak, Linn County, Oregon. Coll. H. M. Gilkey and Dr. and Mrs. D. P. Rogers. Holotype. Preserved in FAA(?).

Leucogaster luteomaculatus Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 394-395. 1924. Cranberry, North Carolina. Coll. R. Thaxter 3. Fragments. Isotype. Holotype in FH.

Leucogaster rubescens Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 395-396. 1924. Under maple, Corvallis, Oregon, 6 May 1922. Coll. L. M. Boozer. Five halves. Holotype.

Leucogaster tozziana (Cavara & Saccardo) Mattirolo in Zeller & Dodge, Ann. Mo. Bot. Gard. 11: 463. 1924. Vallombrosa, Italy, 23 November 1899. Coll. and det. O. Mattirolo. One half sporocarp. Isotype(?) of *Endogone tozziana* Cav. & Sacc., Nuovo Bot. Ital. Ser. II. 7: 296. 1900.

RATA (Vol. 4): p.283, 1.37, for *Diciseda* read *Disciceda;* p.291, 1.14,
r *Octaviana* read *Octaviania.*

Melanogaster euryspermus (Zeller & Dodge) Zeller, Mycologia 31: 8. 1939. In strawberry patch, Rickreall, Oregon, 1 May 1924. Coll. Etta Neiderheiser. Det. S. M. Zeller 2660. Abundant collection. Holotype of *Melanogaster ambiguus* var. *euryspermus* Zeller & Dodge, Ann. Mo. Bot. Gard. 22: 373. 1935.

Melanogaster luteus Zeller, Mycologia 31: 9. 1939. Under vine maple, Trout Creek Camp, Linn County, Oregon, 23 September 1937. Coll. S. M. Zeller 8312. Two halves. Holotype. ≡ *Alpova luteus* (Zeller) Trappe, Nova Hedwigia Beih. 51: 291. 1975.

Melanogaster macrocarpus Zeller, Mycologia 31: 9,11. 1939. In duff under conifers, mostly hemlocks, where pack horses had been tethered, about 100 yards up on trail to Paradise Park from Twin Bridges Forest Camp, Clackamas County, Oregon, 3 September 1935. Coll. S. M. Zeller 8230. Abundant collection. Holotype.

Melanogaster microsporus Mattirolo, Beitr. Krypt.-Flor. Schweiz. 8: 27-29. 1935. Rodero, Como Provence, Italy, M. 500, 1936. One sporocarp. Isotype. ≡ *Alpova diplophloeus* f. *europaeus* Trappe, Nova Hedwigia Beih. 51: 289. 1975.

Melanogaster mollis Lloyd, Mycol. Notes 65: 1047. 1921. Wyoming, Coll. Simon Davis 2030. Two halves. Syntype.

Melanogaster parksii Zeller & Dodge, Ann. Mo. Bot. Gard. 23: 649-650. 1936. Under leaves of *Quercus agrifolia*, Guadaloupe Mines, Santa Clara County, California, 17 April 1918. Coll. H. E. Parks 136 (pro part). Four sporocarps. Syntype.

Rhizopogonaceae

Holocotylon anomalum Zeller, Mycologia 39: 287-288. 1947. On barren soil, Cisco, Eastland County, Texas, July 1938. Collected with *Diciseda brandegeei*. Coll. E. A. Smith. Det. S. M. Zeller 1234. One fragmented sporocarp. Holotype.

Rhizopogon angustisepta Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 24. 1918. Germany. Coll. W. Kruger. Lloyd Mus. No. 6692. Isotype(?). Fragments. Holotype in BPI.

Rhizopogon anomalus A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 32-33. 1966. Pend d'Oreille, Nat. Forest, Copeland, Idaho, 2 September 1922. Mountain road in forest of cedar larch, pine, and hemlock, 3800 ft. Coll. C. H. Kauffman 8 and 16. Three sporocarps. Isotype. Holotype in MICH.

Rhizopogon arctostaphyli A. H. Smith in Smith & Zeller Mem. N. Y. Bot. Gard. 14(2): 35. 1966. Willow Creek, Humboldt County, California, 1935. Coll. J. P. Tracy 5705. Zeller Herb. No. 8273. Three halves. Holotype.

Rhizopogon baxteri A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 105-106. 1966. Univ. of Michigan Forest Nursery, 17 October 1927. Coll. D. V. Baxter 2578. Abundant collection. Isotype

Rhizopogon brownii A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 102-103. 1966. In a pinewood, Denham Springs, Livingston Parish, Louisiana, 16 December 1927. Coll. C. A. Brown. Abundant collection. Holotype.

Rhizopogon brunnescens Zeller, Mycologia 33: 196. 1941. Under logs, Horse Camp Flats, Mt. Shasta, California. Coll. W. B. Cooke 13305. Holotype (?). Three sporocarps. Two Cooke collection numbers (13305, 13306) are given in the original description without either being designated type. Preserved in FAA; later dried.

Rhizopogon burlinghamii A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 121. 1966. In a sandy soil, Pacific Grove, California, January 1937. Coll. G. S. Burlingham. Two sporocarps. Holotype.

Rhizopogon diplophloeus Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 8-9. 1918. In the roof and on the sides of a protruding cliff among rhizomes of *Adiantum*, clinging to rock, Fern Cave, north of Point Caution, near Friday Harbor, Washington, 4 July 1917. Coll. S. M. Zeller. Abundant collection. Holotype. ≡ *Alpova diplophloeus* f. *diplophloeus* (Zeller & Dodge) Trappe & Smith in Trappe, Nova Hedwigia Beih. 51: 286. 1975.

Rhizopogon exiguus Zeller, Mycologia 31: 2. 1939. In duff among mycorrhizal roots of hemlock, Silver Springs Recreational Area, Mt. Rainier National Park, Washington, 18 August 1937. Coll. S. M. Zeller 8278. One sporocarp plus fragments. Holotype.

Rhizopogon gilkeyae A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 72-73. 1966. Corvallis, Oregon, April 1925. Coll. H. M. Gilkey. Three halves. Holotype.

Rhizopogon kauffmanii A. H. Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 38-39. 1966. Near bog, mixed conifers, Pend d'Oreille Nat. Forest, Copeland, Idaho, 11 September 1922. Coll. C. H. Kauffman. Two sporocarp halves. Labelled Isotype but is Paratype since Holotype is Smith 69813 in MICH.

Rhizopogon libocedri A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 117. 1966. Under *Libocedrus decurrens* at Darlingtonia, California, Del Norte County, 2 November 1939. Coll. H. E. Parks. Four halves. Holotype.

Rhizopogon maculatus Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 4. 1918. Growing in sand under pine trees, Golden Gate Park, San Francisco, California, May 1916. Coll. N. L. Gardner. Fragments. Holotype.

Rhizopogon niger (Lloyd) Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 122. 1929. Covered with sand, black without, columella much branched, black, fibrils loose, branched, concolorous, South Africa.

Coll. Miss A. V. Duthie. Lloyd Mus. No. 081. One sporocarp. Isotype(?) of *Hysterangium niger* Lloyd, Mycol. Writ. 7: 1173. 1922.

Rhizopogon occidentalis Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 14. 1918. Moscow, Idaho. Coll. L. F. Henderson. One half sporocarp plus pieces. Holotype.

Rhizopogon pachyphloeus Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 9-10. 1918. Bank among lichens, Cinchona, Jamaica, 4500-5200 ft, wet, mountainous reg., 25 December-8 January 1908-9. Coll. W. A. and E. L. Murrill 605. One sporocarp. Holotype. ≡ *Alpova pachyphloeus* (Zeller & Dodge emend. Trappe) Trappe, Nova Hedwigia Beih. 51: 300-301. 1975.

Rhizopogon pannosus Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 6. 1918. Growing in trampled roadway, Mariposa County, California, June 1916. Coll. W. A. Setchell. One sporocarp. Holotype.

Rhizopogon parksii A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 76-77. 1966. Eight or ten specimens on top of soil beneath the needles. Spruce Cove, Trinidad, California. Coll. H. E. Parks 4626. Four halves. Holotype.

Rhizopogon rogersii A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 73-74. 1966. Hat Point near Imnaha, Wallowa County, Oregon, 25 July 1939. Coll. D. P. Rogers. One sporocarp plus fragments. Holotype.

Rhizopogon separabilis Zeller, Mycologia 31: 3-4. 1939. In sand under *Pinus contorta*, north of Florence, Lane County, Oregon, 22 November 1935. Coll. A. H. Smith, A. B. Hatch, and S. M. Zeller 8236. Abundant collection. Holotype.

Rhizopogon sepelibilis A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 87-88. 1966. Mt. Rainier Nat. Park, Washington, Greenwater, 28 October 1928. Coll. Keith O'Leary. Five halves. Holotype.

Rhizopogon sipei A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 119. 1966. Under Douglas-fir, on the upper McKenzie River, near Clear Lake, Linn County, Oregon, 21 October 1939. Coll. F. P. Sipe. Abundant collection. Holotype. Identified as *Rhizopogon pachyphloeus* Zeller & Dodge.

Rhizopogon tsugae A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 59-60. 1966. Under hemlock, Twin Bridges Forest Camp, Clackamas County, Oregon, 9 August 1937. Coll. Rogers and Zeller. Abundant collection. Holotype.

Rhizopogon villosulus Zeller, Mycologia 33: 196-197. 1941. Under duff of conifers, Hat Point along Snake River Canyon, 23 mi above Imnaha, Wallowa County, Oregon, 26 July 1939. Coll. H. M. Gilkey. Abundant collection. Holotype.

Rhizopogon viridis Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 5. 1918. In pine leaf mold, Priest River, Bonner County, Idaho, September 1917. Coll. J. R. Weir. One half sporocarp. Holotype.

Rhizopogon zelleri A. H. Smith in Smith & Zeller, Mem. N. Y. Bot. Gard. 14(2): 75. 1966. Under coniferous and hazel duff, dense woods, Gresham, Oregon, 28 April 1944. Coll. S. M. Zeller. Abundant collection. Holotype.

Truncocolumella citrina Zeller, Mycologia 31: 6-7. 1939. Under Douglas-fir and incense cedar, 1-4 inches deep under moss and soil, Comstock, Oregon, 20 October 1937. Coll. S. M. Zeller 8320. Two halves. Holotype.

Truncocolumella rubra Zeller, Mycologia 31: 7-8. 1939. Emergent in heavy duff under hemlock, near Denny Creek, not far from Snoqualmie Pass, King County, Washington, 19 August 1937. Coll. D. E. Stuntz. One half sporocarp plus portion in FAA. Holotype.

Hymenogastraceae

Dendrogaster elasmomycetoides Zeller, Mycologia 33: 199-200. 1941. Two inches under Shasta fir duff, Mt. Shasta, Siskiyou County, California, 18 July 1938. Coll. W. B. Cooke. One half sporocarp. Holotype. ≡ *Gymnoglossum elasmomycetoides* (Zeller) Zeller, Mycologia 40: 643. 1948.

Dendrogaster major Zeller & Dodge, Ann. Mo. Bot. Gard. 21: 686. 1934. Under *Quercus agrifolia* on Jasper Ridge near Stanford Univ., 13 March 1928. Coll. J. McMurphy 281. Specimen preserved. Holotype. ≡ *Gymnoglossum majus* (Zeller & Dodge) Zeller, Mycologia 40: 643. 1948.

Dendrogaster radiatus (Lloyd) Zeller & Dodge, Ann. Mo. Bot. Gard. 21: 688. 1934. Underground in leaf mold at foot of trees, Union of So. Africa. Lloyd Cat. No. 30493, Dept. Agric. Mycol. Herb. No. 17795. One fragment. Isotype of *Hymenogaster radiatus* Lloyd, Mycol. Notes 73: 1304. 1925. Holotype in BPI. ≡ *Gymnoglossum radiatum* (Lloyd) Zeller, Mycologia 40: 643. 1948.

Gymnoglossum stipitatum Massee, Grevillea 19: 97. 1891. No data. Three fragments. Isotype(?).

Hymenogaster albidus Massee & Rodway in Massee, Kew Bull. Misc. Inf. 1901: 158. 1901. No data with packet. Coll. Rodway 643. Fragment. Syntype. Portion also at K. ≡ *Gautieria albida* (Massee & Rodw.) Cunningham, Proc. Linn. Soc. New S. Wales 59: 172. 1934. (Sept.). ≡ *Gautieria albida* (Massee & Rodw.) Zeller & Dodge in Dodge & Zeller, Ann. Mo. Bot. Gard. 21: 704. 1934. (Dec.).

Hymenogaster caudatus Harkness, Proc. Calif. Acad. Sci. Bot. III. 1: 248. 1899. Hypogeous under *Sequoia* and *Quercus*, Mill Valley, Marin County, California, April. Coll. Harkness 240. One half preserved sporocarp. Syntype. Holotype in UC. ≡ *Gautieria caudata* (Harkn.) Zeller & Dodge, Ann. Mo. Bot. Gard. 21: 698. 1934.

Hymenogaster monticola (Harkn.) Harkness, Proc. Calif. Acad. Sci. Bot. III. 1: 249. 1899. Mariposa Tree Grove, found at the foot of the Grizzly Giant in vegetable mold, July 1883. Coll. H. W. Harkness 113. Fragment. Syntype(?). ≡ *Gautieria monticola* Harkn., Bull. Calif. Acad. Sci. 1: 30. 1884.

Hymenogaster trabuti sensu Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 137-138. 1918. Growing under oaks near wood rat's nest, rather deeply buried, San Jose County, California, April 1917. Coll. H. E. Parks. Zeller Herb. No. 1455. One half sporocarp. Isotype(?) of *Hymenogaster gautierioides* Lloyd, Mycol. Writ. 7: 1117-1118. 1922. Holotype in BPI(?). ≡ *Gautieria gautierioides* (Lloyd) Zeller & Dodge in Dodge & Zeller, Ann. Mo. Bot. Gard. 21: 697-698. 1934.

Hydnangiaceae

Arcangeliella africana (Lloyd) Zeller & Dodge, Ann. Mo. Bot. Gard. 22: 365. 1935. Stellenbasc, Union of South Africa, February 1922. Sent by Mattirolo. Det. Lloyd 97. Coll. A. V. Duthie 325. Small fragment. Isotype of *Octaviania africana* Lloyd, Mycol. Notes 67: 1142. 1922. Holotype in BPI(?). ≡ *Neosecotium africanum* (Lloyd) Singer & Smith, Madrono 15: 156-158. 1960. According to D. N. Pegler.

Hydnangium aurantium (Harkness) Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 30. 1918. Photo only. Isotype(?) of *Rhizopogon aurantius* Harkness, Proc. Calif. Acad. Sci. Bot. III. 1: 257. 1899. Holotype may be in BPI.

Hydnangium ellipsosporum Zeller, Mycologia 31: 13-14. 1939. Under hemlock, Twin Bridges Forest Camp, Clackamas County, Oregon, 9 August 1937. Coll. D. P. Rogers. Two halves. Paratype.

Hydnangium ellipsosporum Zeller, Mycologia 31: 13-14. 1939. Hypogeous under Douglas-fir, Alsea Mt., Oregon, June 1937. Coll. A. M. and D. P. Rogers 463. Zeller Herb. No. 8457. Specimen preserved. Holotype.

Hydnangium gilkeyae Zeller & Dodge, Ann. Mo. Bot. Gard. 22: 371. 1935. Under hazel on Peoria Rd., Linn County, Oregon, 25 May 1922. Coll. H. M. Gilkey. Two halves. Holotype.

Hydnangium nigrescens Zeller, Mycologia 40: 641. 1948. Partially exposed on the ground in mixed woods, Cornell Plantations, along Fall Creek, east of Floriculture Gardens, Tompkins County, New York, 18 August 1947. Coll. C. T. Rogerson 1615. Four sporocarp halves plus preserved material. Holotype. ≡ *Octavianina nigrescens* (Zeller) Singer & Smith, Mem. Torry Bot. Club 21(2): 11. 1960.

Hydnangium nigricans Kalchbrenner, Grevillea 10: 107. 1882. Under *Acacia* in grassy places at the base of Mt. Baschberg, near Somerset, East C.B.S., February 1876. Coll. Macowan. Three slices. Isotype. Holotype in K or B.

Hydnangium oregonense Zeller, Mycologia 33: 200-201. 1941. In mixed woods, Roaring River Fish Hatchery, Linn County, Oregon, 30 April 1938. Coll. S. M. Zeller 8487. Specimen preserved. Holotype.

Hydnangium setigerum Zeller, Mycologia 31: 14-15. 1939. Under moss in dense coniferous woods, 1/2 mi above Roaring River Fish Hatchery, Linn County, Oregon, 20 March 1934. Coll. S. M. Zeller 8202. Specimen preserved. Holotype.

Hydnangium soehneri Zeller & Dodge, Ann. Mo. Bot. Gard. 22: 372. 1935. "*Hydnangium carneum* Pupplinger Heide bei Wolfratshausen, Fuhrenwald, 21 October 1928. Coll. E. Soehner." One half sporocarp. Isotype. Holotype in M(?).

Gymnomyces vesiculosus Coker & Couch, Gasteromycetes E. U.S. and Can. p. 23. 1928. Chapel Hill, North Carolina, 4 August 1924. Zeller Herb. No. 7470. Fragments. Isotype. Holotype in NCU(?). ≡ *Hydnangium vesiculosum* (Coker & Couch) Zeller, Mycologia 40: 642. 1948.

SEE ERRATA
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Macowania agaricina Kalchbrenner, Gard. Chron. 5: 785. 1876. "G. Massee. 1909." Fragments. Isotype. Holotype in K. ≡ *Macowanites agaricinus* (Kalch.) Kalch., Hedwigia 15(8): 116. 1876. Annotated as *Macowanites agaricinus* (Waldbrenner ex Berk.) Kalch. by R. Singer.

Macowanites alpinus Zeller, Mycologia 39: 291-292. 1947. Under chunks of duff in fir woods below Shasta Alpine Lodge in Cascade Gulch, up 7500 ft on Mt. Shasta, California, 7 September 1942. Coll. W. B. Cooke 16797. Four sporocarp halves. Holotype. ≡ *Elasmomyces alpinus* (Zeller) Zeller, Mycologia 40: 643. 1948.

Octaviana mutabilis E. Bommer & M. Rousseau, Florenville (Ardennes), October 1884. Part of Fungi Gallici Exsiccati. C. Roumeguere 3159. Fragments. Isotype. Holotype in K. See discussion by Smith, Mycologia 54: 629. 1962.

Sclerogaster pacificus Zeller & Dodge, Ann. Mo. Bot. Gard. 22: 370-371. 1935. Under pines and gorse, Bandon-by-the-Sea, Oregon, 27 June 1928. Fragments. Holotype.

GAUTIERIALES

Gautieriaceae

Gautieria parksiana Zeller & Dodge, Mycologia 14: 196-197. 1922. In soil under *Heteromeles arbutifolia*, Santa Clara County, California, 22 March 1919. Coll. H. E. Parks 441. Zeller Herb. No. 1678. Eleven sporocarp halves. Isotype.

Gautieria plumbea Zeller & Dodge, Ann. Mo. Bot. Gard. 5: 138-139. 1918. In rich pine leaf litter, Priest River, Idaho, September to October 1916. Coll. J. B. Weir. One half sporocarp. Holotype.

HYSTERANGIALES

Hysterangiaceae

Hysterangium affine Massee & Rodway var. *oreades* Zeller, Mycologia 31: 18-19. 1939. "The colony formed a semicircular fairy ring about 10 ft. in diameter. The other side of the ring extended into broken ground by *Abies lasiocarpa* (Hook) Nutt., Brighton (Silver Lake), Salt Lake County, Utah. Elev. 9000 ft, July 30, 1936." Coll. G. D. Darker 5873. Abundant collection. Holotype.

Hysterangium album Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 87-88. 1929. "No material or data here. Material collected at Ithaca between 1912 and 1922." Coll. H. M. Fitzpatrick. Zeller Herb. No. 2800. One half sporocarp. Syntype(?).

Hysterangium aureum Zeller, Mycologia 33: 201-202. 1941. Under vine maples and conifers, Trout Creek Recreational Area, Linn County, Oregon, 21 May 1936. Coll. S. M. Zeller 8480. Specimens preserved. Holotype.

Hysterangium cerebrinum (Lloyd) Lloyd, Mycol. Writ. 7: 1119. 1922. Province Mikawa, Japan, 13 October 1914. Coll. A. Yasuda 262. Lloyd Herb. No. 22378. One half sporocarp plus portion in FAA. Isotype of *Rhizopogon cerebrinum* Lloyd, Mycol. Writ. 6: 889. 1919. Holotype in BPI(?).

Hysterangium crassirhachis Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 101-102. 1929. In forest duff, Corvallis, Oregon, November 1922. Coll. S. M. Zeller. One half sporocarp. Paratype(?).

Hysterangium crassirhachis Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 101-102. 1929. Under oak, Corvallis, Oregon, 6 May 1922. Det. S. M. Zeller 2319 and C. W. Dodge 334. Coll. L. M. Boozer. Three sporocarps. Holotype.

Hysterangium darkeri Zeller, Mycologia 31: 17-18. 1939. On ground in coniferous woods, east of Brighton (Silver Lake), Salt Lake County, Utah, elev. 9600 ft, 3 August 1936. Coll. G. D. Darker 5957. Four sporocarp halves. Isotype. Holotype in FH.

Hysterangium inflatum Rodway apud Trotter in Saccardo, Syll. Fung. 24: 1327. 1928. Mt. Wellington, Tasmania. Coll. S. Rodway 1267. Two slices. Syntype. Holotype in K or H.

Hysterangium neglectum Massee & Rodway, Kew Bull. Misc. Inf. 1899: 181. 1899. Hobart, Tasmania. Coll. L. Rodway 614. Two sporocarp halves. Syntype. Holotype in H.

Hysterangium neocledonicum Patouillard, Soc. Mycol. Fr. Bull. 31: 34. 1915. Nouvelle Caledonie, 1910. Coll. M. LeRat. One slice plus fragments. Isotype. Holotype in FH(?).

Hysterangium obtusum Rodway, R. Soc. Tasmania Pap. Proc. 1919: 112. 1920. Tasmania. Coll. S. Rodway 1264. One slice. Syntype. Holotype in H(?). = *Hysterangium sclerodermum* (Cooke) Cunningham, Proc. Linn. Soc. New S. Wales 59: 165. 1934.

Hysterangium pumilum Rodway, R. Soc. Tasmania Pap. Proc. 1917: 109. 1918. Tasmania. Coll. L. Rodway 1268. Five sporocarp halves. Syntype. Holotype in H.

Hysterangium purpureum Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 110-111. 1929. Punta Arenas, Magellanes, Chili. Coll. R. Thaxter "hypogeous No. 12." Det. S. M. Zeller. Abundant collection. Isotype. Holotype in FH(?).

Hysterangium separabile Zeller, Mycologia 33: 203-204. 1941. Under vine maple and conifers, Trout Creek Forest Camp, Linn County, Oregon, 21 May 1938. Coll. S. M. Zeller 8479. Abundant collection. Holotype.

Hysterangium stoloniferum var. *brevisporum* Zeller, Mycologia 39: 288. 1947. Under moss beneath vine maple, Trout Creek Recreational Area, Linn County, Oregon, 21 May 1938. Coll. and det. S. M. Zeller. One sporocarp plus two halves. Holotype.

Hysterangium strobilus Zeller & Dodge, Ann. Mo. Bot. Gard. 16: 90. 1929. Under beech, Burbank, Tennessee. Coll. R. Thaxter. One slice. Holotype in FH.

Phallobata albida Cunningham, Trans. N.Z. Inst. 56: 73. 1926. On decaying wood in forest floor, Whakatikei Forest Reserve, Paikakanki, Wellington, 6 April 1923. Coll. J. C. Neill and J. G. Myers. Det. G. H. Cunningham 1187. Two sporocarps plus fragments. Isotype. Holotype in PDD. ≡ *Hysterangium lobatum* Cunningham, Trans. R. Soc. N.Z. 67: 408. 1938.

Protophallaceae

Calvarula excavata Zeller, Mycologia 31: 25-26. 1939. Coconut grove, Florida, November 1897. Coll. R. Thaxter. Det. S. M. Zeller. Specimen preserved. Isotype. Holotype in FH.

Protophallus brunneus Zeller, Mycologia 31: 28-29. 1939. In a park, Buenos Aires, 3 February and March 1906. Coll. R. Thaxter. Specimen preserved. Isotype. Holotype in FH. ≡ *Protubera brunnea* (Zeller) Zeller, Mycologia 40: 644. 1948.

Protophallus jamaicensis Murrill, Mycologia 2: 25. 1910. Wet mountainous region, Cinchona, Jamaica, elev. 4500-5200 ft, 7 January 1909. Coll. W. A. Murrill 567 and E. L. Murrill. Two small enclosed packets of slices plus fragments. Holotype. ≡ *Protubera jamaicensis* (Murr.) Zeller, Mycologia 40: 644. 1948.

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MYCOTAXON

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NOMENCLATURE OF MELAMPSORIDIUM BETULINUM

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The nomenclature of the common birch rust, *Melampsoridium betulinum* has been investigated. The conclusions agree with those of Hylander, Jørstad and Nannfeldt (1953) rather than with those of Boerema (1970).

Uredo populina B *Uredo betulina* Pers., Syn. Meth. Fung. :219, 1801. This name represents the uredinial state of *Melampsoridium betulinum.*

Peziza betulina Alb. & Schw., Consp. Fung. :339, 1805 (as *'P. betulina* nobis'; Albertini & Schweinitz also gave *'U. populina B betulina'* as a separate species - p. 125). Although this species has been given as *Mollisia betulina* (Alb. & Schw.) Rehm, Berichte Bayer Bot. Gesellsch. 14:96, 1914, its identity remains uncertain as the type material has not been found. However the species is illustrated and shown as regular circular objects with a central depression or ostiole. Compared with the serrations of the leaf they appear to be within 1 to 5 mm diam., probably about 2-3 mm. The size and regular shape seem to rule out the uredinia and telia of *Melampsoridium betulinum,* and the size also rules out other fungi such as *Venturia ditricha* and *Phyllactinia guttata* or *Microsphaeria betulae.* The possibility that they represent galls of insect origin should perhaps be considered. In any case we may conclude that this name is to be treated as 'devalidated', and as such should not be considered the basionym of later published valid names which appear to apply to different organisms.

Sclerotium betulinum Fries, Syst. Myc. 2:262, 1822. This name is represented by Fries Scler. Suec. exs. 426, 1834, which in K and UPS bears profuse telia of *Melampsoridium betulinum*, and there is little doubt that this is what was described by Fries. Although cited with the synonym "Peziza. A.S. p.339" (=*P. betulina*), the latter need not be considered the basionym because it is devalidated, and should not, on account of the different identity. The specimen referred to above can be considered the neotype.

Perisporium betulinum Fries, Syst. Myc. 3:249, syn: *'Peziza betulina* Alb. & Schwein. p. 339'; no reference to *Sclerotium betulinum* or to Scler. suec. 426). This name is represented by Fries, Scler. suec. exs. 374, which in K and UPS bears no *Melampsoridium*, and nothing else except perithecia of *Venturia ditricha* (Fr.) Karst. There seems little doubt that Fries changed his concept from that of *S. betulinum* given in Syst. Myc. 2, however whether he was really describing *V. ditricha* or something else remains uncertain. In any case the name may be considered as new (for the same reasons as *S. betulinum*) and referring to a species different from that of *S. betulinum*, with Scler. suec. 374 as the type.

Melampsora betulina (Fries) Desm., Pl. Crypt. Fr (exs.) I n. 2047, 1850; II n. 1647 (1850?) (syn.: *'Sclerotium betulinum*, Fr. Syst. Myc.') (note: this combination not given in Desm., Ann. Sci. Nat. Bot. III 4:107-118, 1850, cf. Boerema, 1970). The above specimens (in K) clearly apply to *Melampsoridium betulinum*, and thus agree with the basionym.

Melampsora betulina (Pers.) Wint., Hedw. 19:55, 1880 (as *'betulina* (Pers.)', no synonyms given and no description). Applies to the imperfect state, but placed in a 'perfect' genus, therefore invalid (Art. 59, par. 4).

Melampsora betulina Wint., Rabenh. Kryptog. Fl. II 1 (1) : 238, 1884 (as *'M. betulina* (Pers.).', syn. *'Uredo populina* B *betulina* Pers'., no reference, direct or indirect to *Peziza betulina* Alb. & Schw., nor to Desmazières, but *'P(erisporium) betulinum* (Alb. & Schw.)' is given as a separate species (1(2):68). Includes description of telia and therefore is treated as new and attributed to Winter alone - Art. 59, par. 4), *nom. illeg.* (later homonym of *M. betulina* (Fries) Desm.).

Melampsoridium betulinum (Fries.) Kleb., Z. Pfl. Kr. 9: (17-)22, 1899 (cites only *'Melampsora betulina* (Pers.) Desm.' and refers to Plowright, Z. Pfl. Kr. 1:130, which cites *'Melampsora betulina* (Pers.) Wtr.' Includes description and illustration of telia). It seems likely that Klebahn intended to adopt the concept of this species as that of Persoon, Desmazières and Winter, and intended to reject *Peziza betulina* Alb. & Schw. as referring to a different species. Since Klebahn's name is applied inclusive of telia, *U. betulina* Pers. cannot be considered the basionym. However the author citation may be revised under Art. 33, Note 2 (bibliographic errors of citation) and so indicate the correct basionym *S. betulinum* Fries, which is indirectly cited by Klebahn through the reference to Desmazières.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. XI. ADDITIONS TO THE GENERA *CERCOSPORIDIUM*, *PASSALORA* AND *PHAEOISARIOPSIS*

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ABSTRACT

Cercospora cassiocarpa (Sacc.) Chupp and *C. equadoriana* O. Const. are reclassified in *Cercosporidium* Earle, *Cercospora nodosa* O. Const. in *Passalora* Fries and *Cercospora sphaeroidea* Speg., in *Phaeoisariopsis* Ferraris. The fungi are redescribed and illustrated.

INTRODUCTION

A considerable number of fungi have been classified as species of *Cercospora* Fres., but in recent years this generic entity as accepted in the past has been recognized to be heterogeneous in character. Critical revision of generic concepts within the "*Cercospora* complex" has yielded more satisfactory generic dispositions for a number of taxa (Deighton, 1967). Examination of type specimens of a number of additional species currently classified in *Cercospora* has indicated that they are more suitably accommodated in other genera. Four such species are considered herein and appropriate transfers made.

TAXONOMIC PART

Cercosporidium cassiocarpum (Sacc.) comb. nov. (Fig. 1).

≡ *Cercospora occidentalis* Cooke var. *cassiocarpa* Saccardo, Ann. mycol. 11: 557, 1913.

≡ *Cercospora cassiocarpa* (Sacc.) Chupp, A monograph of the fungus genus *Cercospora* 290, 1953.

Lesions on pods dark brown, with no distinct border, frequently oriented transversely and up to four times longer than broad. Colonies effuse or orbicular, brown,

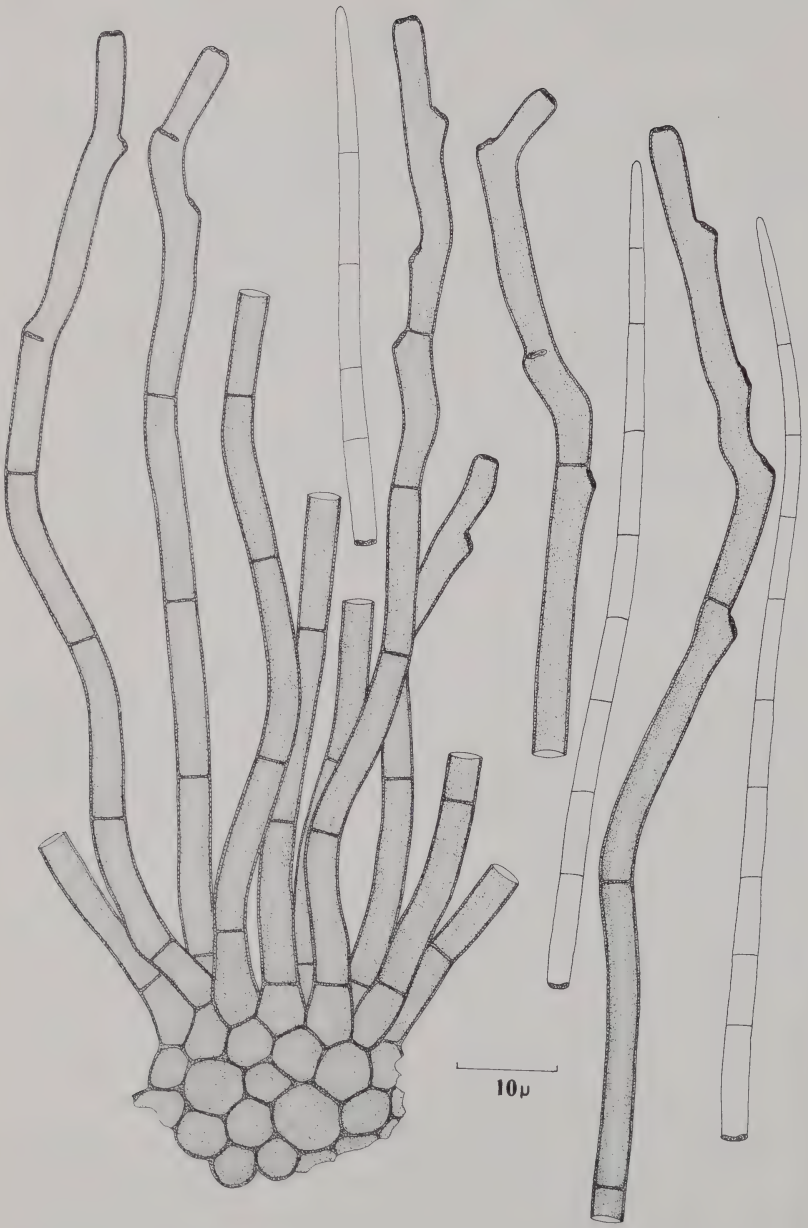

FIGURE 1. *Cercosporidium cassiocarpum*. Conidia and conidiophores.

hairy. Mycelium immersed in the substratum, composed of branched, septate, olivaceous brown to pale yellowish brown, 4 - 6μm wide hyphae. Stromata largely immersed, occasionally partly exposed, subglobose, prosenchymatous to pseudoparenchymatous, brown, 15 - 35μm wide. Conidiophores macronematous, mononematous, densely fasciculate, arising from the upper cells of the stromata, simple, straight to somewhat flexuous, smooth-walled, yellow brown to brown, paler towards the tip, geniculate distally, relatively thick-walled, 4 to 9-septate, scars prominent, 50 - 180 X 4 - 4.5μm. Conidiogenous cells polyblastic, cylindrical, integrated, terminal or intercalary. Conidia holoblastic, solitary, dry, acropleurogenous, straight or slightly curved, long cylindrical, attenuating gradually towards the apex, with several indistinct septa, smooth, tip obtuse, base subtruncate with a prominent scar, 36 - 90 X 4 - 5μm.

On pods of *Cassia occidentalis* L.; S.E. Asia.

Specimen examined: on *Cassia occidentalis*, Manila, Luzon, Philippines, 1912, E. D. Merrill (8463), type, BPI.

The conidia of *C. cassiocarpa* are not entirely typical of those of *Cercosporidium* being longer, more slender and possessing more septa than is usual. The dense fascicles of conidiophores, the well developed stromata and a tendency for the conidiophores to incurve indicate its affinity with this genus however.

Cercosporidium ecuadorianum (O. Const.) comb. nov. (Fig. 2).

≡ *Cercospora ecuadoriana* O. Constantinescu, Mycotaxon 3: 120, 1975.

= *Cercospora psoraleae* Petrak, Sydowia 4:572, 1950 [non *Cercospora psoraleae* Ray, Mycologia 33: 176 176, 1941].

Leaf spots orbicular to irregular, sometimes bordered by leaf veins, occasionally coalescing, cream to pale yellow in the center with a brown border. Colonies effuse or limited, brown, hairy. Mycelium immersed in the substratum, composed of branched, septate, pale brown hyphae, 3 - 4μm wide. Stromata immersed, occasionally partly exposed, substomatal, prosenchymatous to somewhat pseudoparenchymatous, up to 40μm wide. Conidiophores fasciculate, arising from the upper cells of the stromata, hypophyllous, macronematous, simple, straight or slightly flexuous, smooth-walled, pale brown, paler towards the tip, cylindrical, frequently somewhat bulbous at the base, 2 to 3-septate, geniculate above, incurved, scars prominent, 33 - 94 X 4.5 - 5.5μm. Conidiogenous cells polyblastic, integrated, terminal, sympodial. Conidia holoblastic,

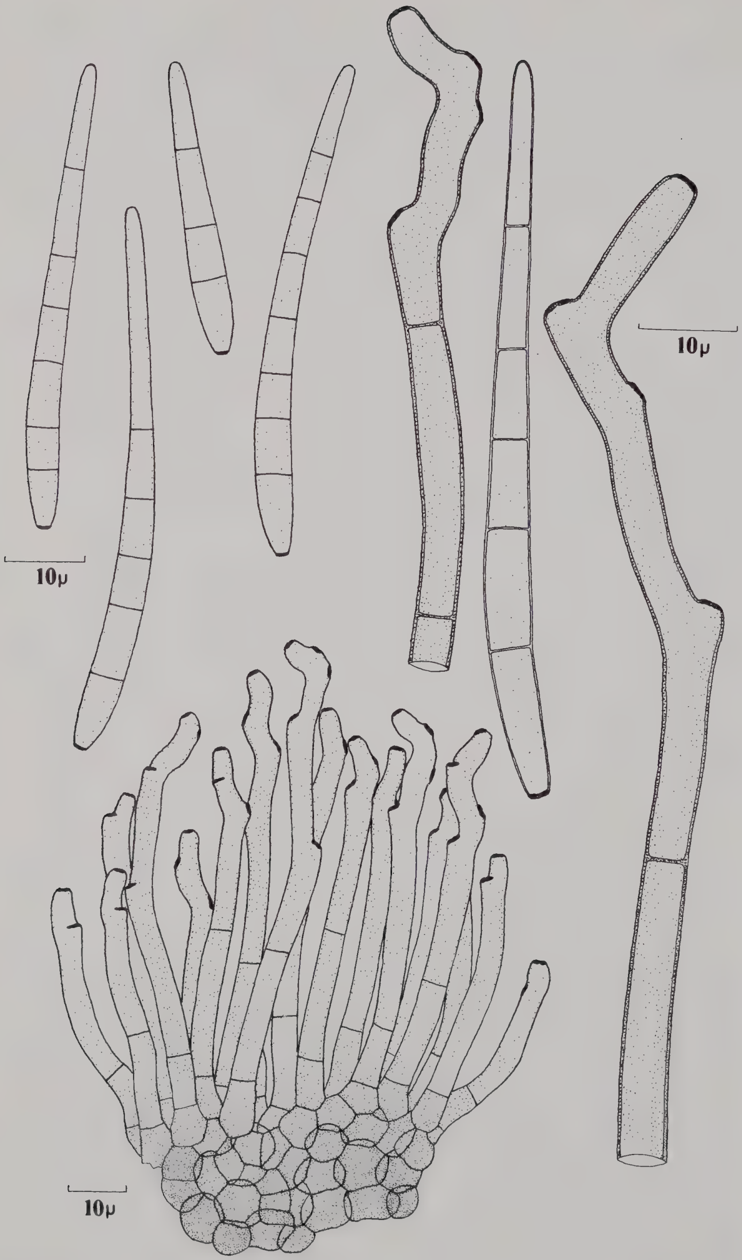

FIGURE 2. *Cercosporidium equadorianum*. Conidia and conidiophores.

solitary, dry, acropleurogenous, straight or slightly curved, obclavate, pale brown to subhyaline, smooth, 1 to 9-septate, obtuse at the apex, conico-truncate with a flattened scar to the base, 36 - 76 X 5.5 - 6μm.

On leaves of *Psoralea* sp.; South America.

Specimen examined: on *Psoralea* sp., Pichicha, near Quito, Ecuador, September 13, 1937, P. Sydow, type, M.

Passalora nodosa (O. Const.) comb. nov. (Fig. 3).

≡ *Cercospora nodosa* O. Constantinescu, Mycotaxon 3: 122, 1975.

Leaf spots dark brown, irregular, angular when bordered by veins, frequently coalescing, 1 - 3mm wide. Colonies effuse or orbicular, brown. Mycelium immersed in the substratum, composed of branched, septate, subhyaline, 2 - 3μm wide hyphae. A few hyphae, composed of swollen, very pale brown cells, aggregate in substomatal cavities and give rise to fascicles of conidiophores. Conidiophores macronematous, mononematous, caespitose, emerging through the stomata, simple, straight or flexuous, cylindrical, frequently irregularly swollen towards the tip, smooth, 1 to 2-septate, scars thin, 18 - 40 X 4 - 6μm Conidiogenous cells polyblastic, integrated, terminal. Conidia holoblastic, solitary, dry, acropleurogenous, very pale brown, smooth-walled, straight or more usually curved, 1 to 6-septate, obclavate, basal cell somewhat swollen, ellipsoid to doliiform and occasionally minutely verruculose, upper cells subcylindric terminating in an obtuse apex, base truncate, 70 - 160 X 3 - 5μm.

On leaves of *Psoralea* species; Europe and Asia.

Specimen examined: on *P. bituminosa*, Botanical Garden, Bucarest, Romania, September 23, 1966, O. Constantinescu, type, IMI 151119.

Constantinescu (1975) noted this species to be an "atypical" *Cercospora*. The thin scars, swollen conidiophore apices and basal conidial cells all indicate that it belongs in *Passalora*. It most closely resembles *P. alni* (Chupp and Green) Deighton.

Phaeoisariopsis sphaeroidea (Speg.) comb. nov. (Fig. 4).

≡ *Cercospora sphaeroidea* Spegazzini, Anal. Soc. Cient. Arg. 1: 59, 1880.

= *Cercospora iponemensis* P. Hennings, Hedwigia 48: 18, 1909.

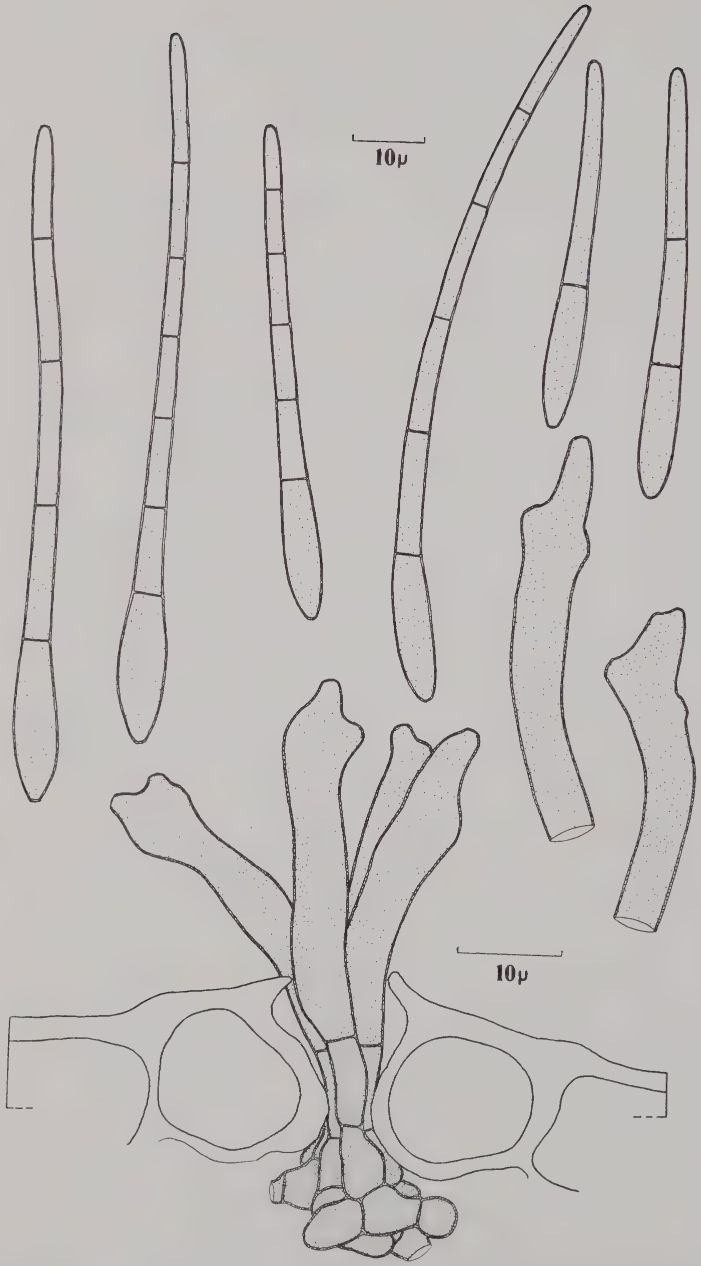

FIGURE 3. *Passalora nodosa*. Conidia and conidiophores.

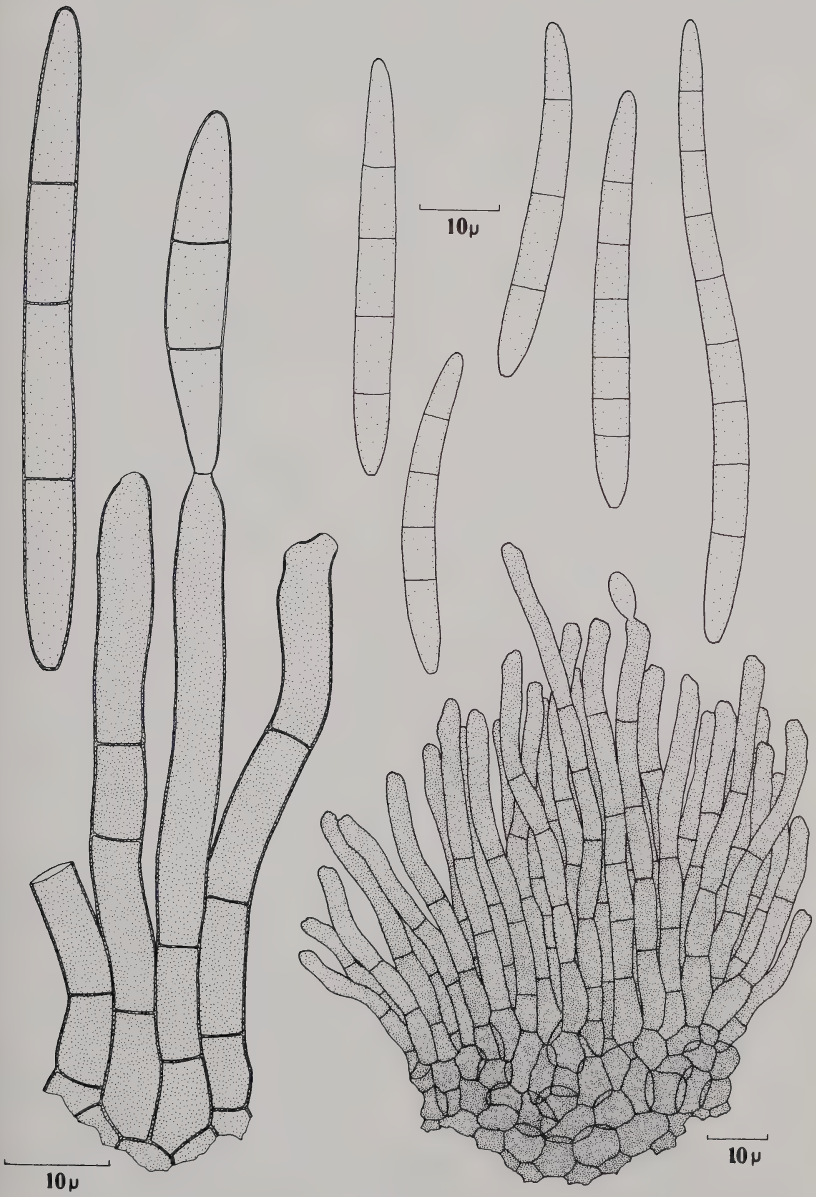

FIGURE 4. *Phaeoisariopsis sphaeroidea*. Conidia and conidiophores.

Leaf spots orbicular to irregular, frequently angular and bordered by the larger leaf veins, reddish-brown to brown, with a blackish margin, crowded or scattered. Colonies limited, dark brown, hairy. Mycelium immersed in the substratum, composed of branched, septate, pale brown, 3 - 4μm wide hyphae. Stromata partly immersed, partly erumpent, well developed, subglobose to somewhat flattened, mostly pseudoparenchymatous, dark brown, 50 - 230μm wide. Conidiophores macronematous, mononematous, densely fasciculate, parallel, straight,or slightly flexuous, arising from the upper cells of the stromata, amphigenous but mostly epiphyllous, up to 5-septate, smooth-walled, olivaceous brown, paler towards the tip, cylindrical, simple, scars thin, 30 - 90 X 4.5 - 5μm. Conidiogenous cells mono or polyblastic, integrated, terminal. Conidia holoblastic, solitary, dry, acropleurogenous, straight or slightly curved, cylindrical to narrowly obclavate, very pale brown, smooth, 2 to 8-septate, obtuse at the apex, subtruncate at the base, 47 - 110 X 3.5 - 4.5μm.

On leaves of *Cassia* species; South America.

Specimens examined: on *C. corymbosa* Lam., San Jose de Flores, Buenos Aires, Argentina, April 15, 1880, C. Spegazzini (911), type, LP; on *Cassia* sp., Iponema, Sao Paulo, Brazil, April 1903, A. Puttemans (732), (type of *C. iponemensis*), B.

ACKNOWLEDGMENT

We are grateful to the curators of the herbaria at Beltsville, Berlin, Kew, La Plata and Munich for making available for examination the collections housed at their respective institutions.

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MYCOTAXON

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PSEUDOXENASMA, A NEW GENUS OF CORTICIACEAE (BASIDIOMYCETES)

by

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A new generic name and a new species *Pseudoxenasma verrucisporum* are proposed.

Pseudoxenasma nov. gen. K.-H. Larss. & Hjortst.

Fructificatio resupinata, effusa, tenuis, hymenio plus minusve sicco firmo ceraceo; systemate hyphali monomitico, hyphis plerumque indistinctis; sulphocystidiis clavatis, appendicibus apicalibus instructis; basidiis clavatis, basibus interdum biradicatis; sporis late ellipsoideis vel subglobosis, verrucosis amyloideis.

GENERITYPUS: *Pseudoxenasma verrucisporum* K.-H. Larss. & Hjortst.

Fruitbody resupinate, effused, thin, hymenium more or less ceraceous, generally smooth. Hyphal system monomitic with the individual hyphae indistinct. Always with sulphocystidia i.e. with positive reaction to sulphovanilline as in *Gloeocystidiellum*. The cystidia are provided with globose apical appendices (schizopapilles according to Boidin and Lanquetin). Basidia clavate, in most cases pleurobasidiate, with four sterigmata. Spores verrucose, thickwalled, broadly ellipsoid to subglobose in side view and with strong amyloid reaction.

Pseudoxenasma verrucisporum nov. spec. K.-H. Larss. & Hjortst.

Fructificatio semper resupinata, effusa, tenuis, hymenio plerumque albido vel cinereo sensim ravido, pruinoso, ceraceo, margine nusquam perspicuo; hyphis indistinctis, tenuitunicatis, 1,5-2,5 um latis, fibulatis; sulphocystidiis cla-

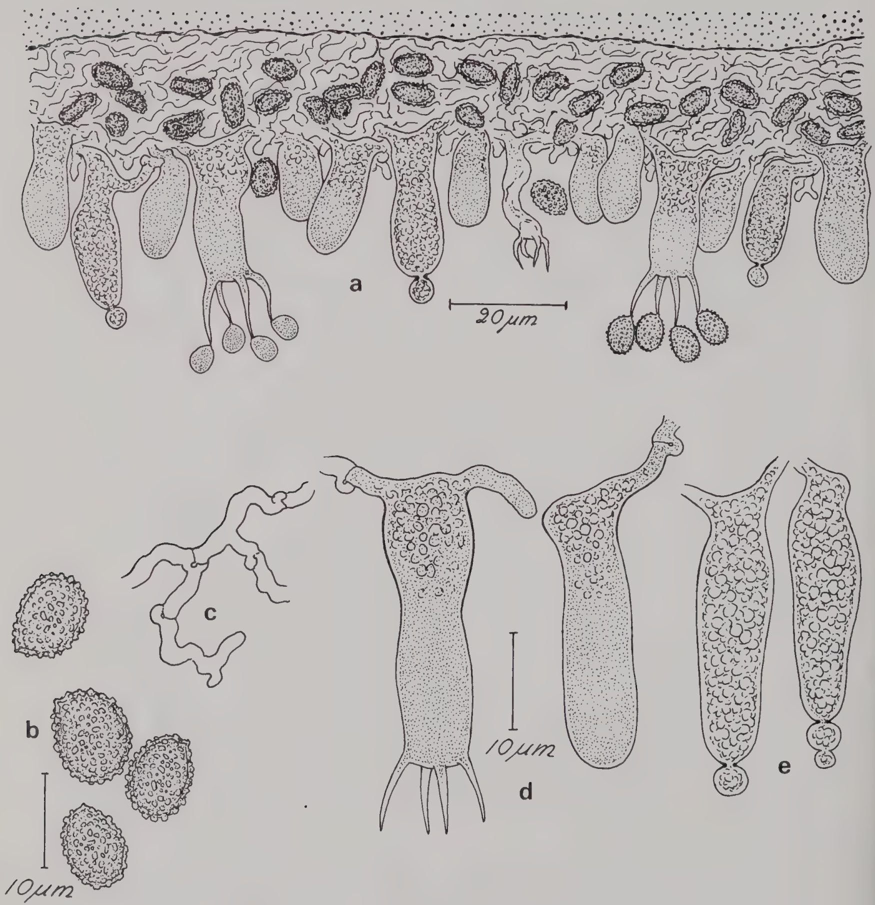

Fig. 1. *Pseudoxenasma verrucisporum*. a) section through fruitbody with lots of old spores enclosed in the texture b) spores c) part of hypha d) basidia e) cystidia. - Section a from type specimen, other details from coll. 6042.

vatis, appendicibus apicalibus instructis, 20-35 x 4-9 um; basidiis clavatis, infra plerumque lateralibus interdum biradicatis 25-35 x 7-9 um, 4 sterigmatibus; sporis crassitunicatis late ellipsoideis vel subglobosis, verrucosis, 8-10 x 7-8 um, valde amyloideis.

HOLOTYPUS: Sweden. Västergötland. Töllsjö par., SW of the little lake Skogstjärn, near Lafsån, on branches of decayed *Picea abies*. 1972-08-06, KHL & Hjortst. no. 5593.

FRUITBODY resupinate, effused, closely attached to the substrate, often of small dimension, ceraceous, thin, whitish to greyish white, hymenium pruinose under the lens or slightly furfuraceous, in dried condition almost hard, margin indistinctly thinning out. Hyphal system monomitic, hyphae narrow, thinwalled, in most cases very indistinct, 1,5-2,5 um wide, with clamps, richly branched. There are lots of old spore hides enclosed in the hyphal texture. Sulphocystidia rather frequent, 20-35 x 4-9 um, with one ore two, rarely in numbers of three to four apical outgrowths, the base of the cystidia is sometimes oblique. Basidia generally pleurobasidiate, clavate, 25-35 x 7-9 um, with four sterigmata which are 9-11 um long. Basidiospores broadly ellipsoid to subglobose, thickwalled, verrucose 8-10 x 7-8 um, and with strongly amyloid reaction.

HABITAT. On fallen branches and trunks as well as on dead but still attached branches of *Picea* in humid forests. The species grows often together with e.g. *Aleurodiscus amorphus* (Fr.) Schroet., *Globulicium hiemale* (Laurila) Hjortst., and *Gloeocystidiellum furfuraceum* (Bres.) Donk.

DISTRIBUTION. Hitherto little known and collected by the authors in Västergötland and Dalsland. By Hauerslev collected in Halland. Not known elsewhere.

REMARKS. The species agrees in essential details with *Xenasma* Donk and *Xenasmatella* Oberw. (pleurobasidia; dense, ceraceous texture) but we have found it necessary to refer it to a genus of its own. The main reason is the presence of sulphocystidia which make it differ from *Xenasmatella* and verrucose, amyloid spores which make it differ from *Xenasma*. *Gloeocystidiellum* Donk em. Donk could have been a proper place for the new species thanks to the sulphocystidia and the amyloid spores but pleurobasidia do not exist in this genus. The new genus reminds in some respects also of *Aleurodiscus* Rabenh. ex Schroet. but has not any acanthohyphidia, characteristic for this genus. Besides *Aleurodiscus* has mainly terminal basidia. Accordingly the species combines characters from at least three genera which are hitherto

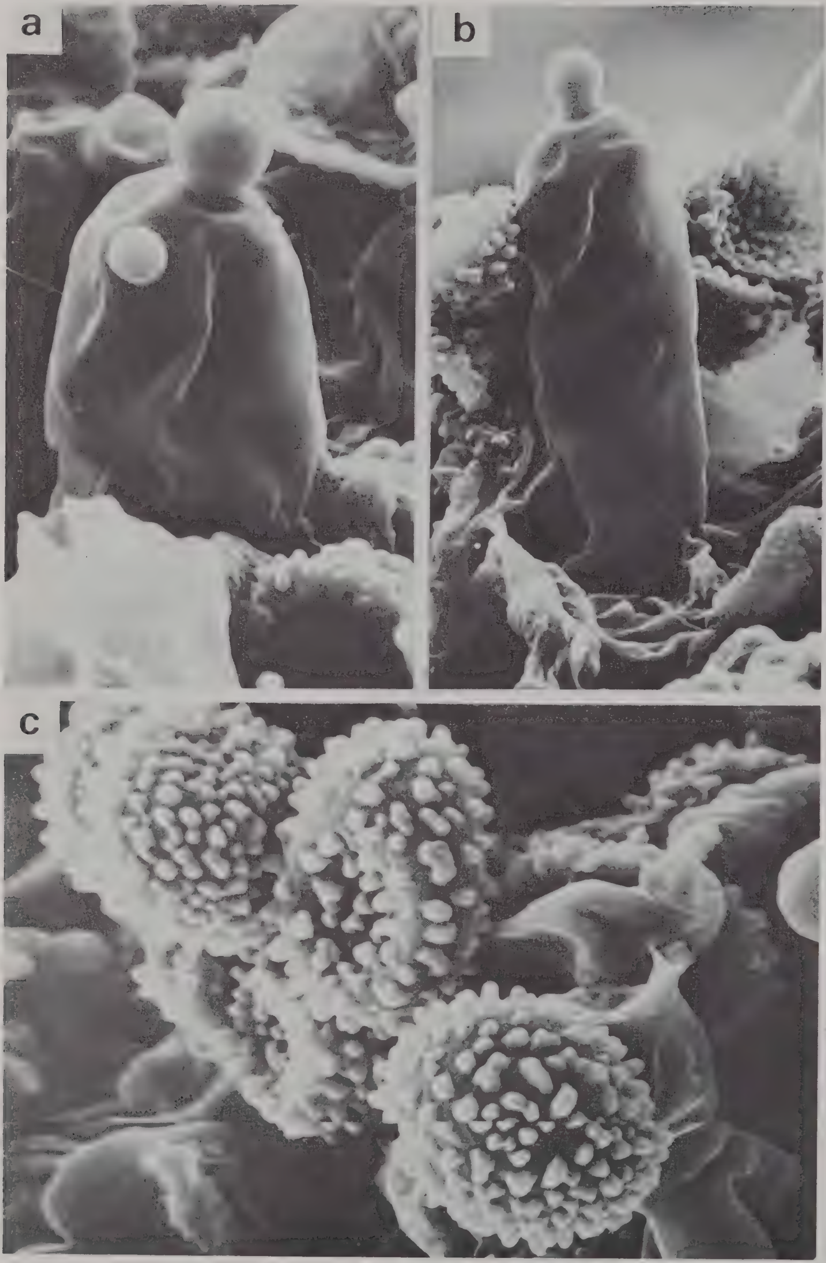

Fig. 2. *Pseudoxenasma verrucisporum*. a and b) sulphocystidia with apical appendix (in b with two) c) spores. - Coll. 6042.

considered as very little connected with each other.

The new species differs from *Xenasma amylosporum* Parm. in the larger size of the spores. This species also lacks the sulphocystidia.

ADDITIONAL MATERIAL STUDIED.

HALLAND. Halmstad, Simlångsdalen. 1970-10-03 K. Hauerslev.

VÄSTERGÖTLAND. Alingsås, east side of lake L. Trän, on stem of *Picea,* rather decayed in *Dicranum* forest. 1971-09-04 KHL 121; S of lake Valsjön, on dead but still attached branches of *Picea*.1972-11 KHL 1478; Skepplanda, S of lake Svillesjön, on *Picea* branch among *Sphagnum* in moist coniferous forest. 1972-09-24 KHL 1153; Horla par., N of Kollsered in brook valley, on still attached branches of *Picea*. 1976-05-16 Hjortst. 6596; Töllsjö par., SW of lake Skogstjärn, near Lafsån, on still attached branches of *Picea*. 1972-08-06 KHL & Hjortst. 5547; Östad par., SE of lake Grytesjön, in brook valley, on rather decayed trunk of *Picea* in *Dicranum-Picea* forest. 1972-08-13 KHL 821; SE of lake Kangekärr, on *Picea* stem on the ground. 1972-09-15 KHL 986 and 1004; NW of the little lake Långevatten, on dead but still attached branches of *Picea*. 1975-12-29 Hjortst. 6556.

DALSLAND. Ör par., W of the lake Örsjön in brook valley, on decayed trunk of *Picea* on the ground. 1972-11-03 KHL & Hjortst. 6042 and 6063.

ACKNOWLEDGEMENTS

We are much indebted to Dr. John Eriksson, Göteborg, for valuable discussions and for his excellent drawings of the species. Our sincere thanks also to Dr. Leif Ryvarden, Oslo, for his work with the scanning-pictures, to Prof. Åke Fridh, Göteborg, for advice with the Latin diagnosis, and to Dr. Luella Weresub, Ottawa, who has carefully examined the new species.

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REVUE DES LIVRES

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RECHERCHES MYCOSOCIOLOGIQUES DANS LES FORETS DE HAUTE BELGIQUE. ESSAI SUR LES FONDEMENTS DE LA SOCIOLOGIE DES CHAMPIGNONS SUPERIEURS, par † Fredi DARIMONT, édité par Jacques LAMBINON, Tome I, xiii + 220 p., 1 carte, 26 photos, 34 aquarelles de J. DAMBLON, Tome II, tableaux hors texte, 4°, broché, 1973. Mémoire no. 170, Institut Royal des Sciences Naturelles de Belgique, 31 rue Vautier, B-1040 Bruxelles. Prix 4000 FB, US $ 100.oo.

Résultat de 10 années de recherches et d'études, la thèse doctorale de feu Prof. Fredi DARIMONT, défendue en 1952, est une oeuvre monumentale, originale et unique qui, heureusement pour nous, a reçu les honneurs d'une excellente édition grâce aux soins du Prof. J. Lambinon de l'Université de Liège.

L'auteur, Fredi DARIMONT, est licencié en sciences botaniques à l'Université de Liège en 1941, y devient assistant à la Chaire de phytosociologie, est promu Docteur en sciences botaniques en 1952 et est nommé Chargé de Cours de la même Université en 1957. En plus de ses charges académiques, il exerça les hautes fonctions de Chef de Cabinet du Ministre de l'Instruction Publique, puis de Directeur Général de l'Enseignement Supérieur et de la Recherche Scientifique de Belgique. Auteur de 53 publications de botanique et de mycologie, il futaussi rédacteur en chef de la revue botanique Lejeunia. Enlevé accidentellement à son activité débordante en 1966, il laissa le souvenir d'un botaniste et mycologue brillant et dévoué.

Ses recherches sur la sociologie des champignons dans les forêts de Haute Belgique l'ont amené à établir les principes, la méthode et les premières structures de la Mycosociologie, fondements d'une science nouvelle, parallèle mais distincte de la phytosociologie.

Vingt quatre ans après son achèvement, ce travail reste actuel et acquiert d'autant plus d'attrait qu'il est resté sans devancier et que, dans l'analyse des biocénoses fongiques, sa nécessité se fait sentir aujourd'hui plus que jamais.

Etant donné la nature hétérotrophe des champignons, l'auteur observe que les facteurs phytosociologiques ne sont pas ceux qui règlent la sociologie des mycocénoses. La chorologie (étude de la distribution géographique) et l'écologie des champignons permettent de définir certains des facteurs mycosociologiques, mais elles ne peuvent fournir à la mycosociologie une méthode d'étude appropriée. L'auteur est donc amené, dans la 2e partie, à mettre sur pied une méthode de travail propre à la mycosociologie.

Il crée d'abord une série de concepts nouveaux. En parallèle des concepts de végétation, flore, liste floristique réservés aux

Végétaux, de population animale, faune, liste faunistique réservés aux Animaux, il introduit pour les Mycètes des concepts de *mycétation*, *fonge* et *liste fongistique*. Il définit aussi le *mycotope* dont les facteurs déterminants sont l'association végétale, le sol, l'altitude, le climat et le support de la mycétation. Le mycotope héberge une *unité de mycétation* ou *synmycie*, représentant un groupement mycosociologique. L'ensemble mycotope et synmycie constitue la *mycosynécie*.

Afin de caractériser, comparer et classer les synmycies, le mycosociologue établit d'abord la liste fongistique de la mycétation et applique à chaque espèce relevée un coefficient de *fréquence* et un indice de *sociabilité*. L'auteur renonce au dénombrement des *unités fongiques* réelles, parce qu'inaccessibles dans leurs limites mycéliennes; mais ce sont les stations où apparaissent un ou plusieurs carpophores qu'il dénombre et traduit par un coefficient de fréquence de 1 à 5. La *sociabilité* est caractérisée par la disposition des carpophores dans les stations, séparée (s), grégaire (g), cespiteuse (c), imbriquée (i), adjointe (a) ou circulaire (o), ces indices pouvant être aussi combinés (gc, oc, ic), et par leur nombre exprimé par un coefficient d'*abondance sociale* de 1 à 5. Le *type physionomique* de chaque espèce est aussi relevé: facies agaricoïde, pleurotoïde, stéréoïde, tremelloïde, pézizoïde, etc. Pour couvrir toute la synmycie d'un mycotope, les relevés mycosociologiques doivent être répétés au cours de la même année et durant plusieurs années. La *liste fongistique cumulative* ainsi obtenue met en évidence le rythme saisonnier de la mycétation.

Cette analyse étant faite, vient alors la synthèse des données. D'abord le mycosociologue compare les synmycies relevées dans des mycotopes identiques mais situés en des lieux différents et en établit la *constance* des espèces. Il compare ensuite les synmycies caractéristiques de mycotopes différents, afin d'en dégager les affinités et les classer en une taxonomie mycosociologique. Les taxa en sont la *sociomycie* (suffixe -*ecium*), l'*alliance* (-*ecion*), l'*ordre* (-*ecia*) et la *classe* (-*ecea*), à l'instar des taxa phytosociologiques d'association (-*etum*), d'alliance (-*ion*), d'ordre (-*etalia*) et de classe (-*etea*).

Dans la 3e partie de l'ouvrage, l'auteur livre les résultats de ses études et une première taxonomie mycosociologique de la mycétation des forêts caducifoliées calcicoles et silicicoles de Haute Belgique. L'auteur a exploré six associations végétales forestières de type *Quercetum*, *Fagetum*, *Querceto-Carpinetum*, *Querceto-Lithospermetum* et *Acereto-Fraxinetum*, dans 123 stations différentes. Dans celles-ci, il y a reconnu 21 mycotopes types (hypogé, endogé, épigé sur litière, épigé sur sol nu, bryophile, épixyle de brindilles, de souches, de branches et troncs couchés, de troncs debout, et de bois de cîme, carbonicole, marécageux, etc.). Dans chaque mycotope particulier, il a relevé la synmycie avec la liste des espèces, leur fréquence, leur sociabilité, leur constance, leur type physionomique et leur rythme saisonnier. Il décrit ainsi 70 mycosynécies différentes avec leur synmycie caractéristique.

Les 22 les mieux caractérisées des 70 synmycies observées sont alors dénommées et décrites par l'auteur comme sociomycies nouvelles (p. ex. *Amanitecium muscariae*, sociomycie du mycotope épigé de litière du *Quercetum sessiliflorae*, et *Amanitecium caesareae*, sociomycie du mycotope épigé du *Querceto-Carpinetum medioeuropaeum caricetosum glaucae*). Les sociomycies sont alors classées en alliances (*Boletecion scabri*, dans l'exemple choisi), celles-ci en ordres

(Boleto-Amanitecia) et les ordres en classes (Cortinario-Boletacea) L'auteur reconnaît ainsi six classes de mycétation, caractérisées par leur physionomie. Il en dénomme quatre: Dasyscyphecea à mycétation forestière endogée (de litière), Cortinario-Boletacea, à mycétation forestière épigée, Anthracobiecea, à mycétation carbonicole, et Stereo-Trametecea, à mycétation forestière épixyle. Il reconnaît encore 2 classes de mycétation, forestière hypogée et forestière bryophile, mais ne les dénomment pas, étant insuffisamment connues. Cette première nomenclature mycosociologique comprend donc déjà 4 classes, 8 ordres, 16 alliances et 22 sociomycies.

La description de ces taxa comprend les espèces caractéristiques de la classe, les espèces exclusives et électives de l'ordre et de l'alliance, les espèces exclusives et électives de la sociomycie, les espèces différentielles de l'étage des collines, le nombre de taxa recensés, le taux de constance, le taux de fréquence, les espèces dominantes, les spécialisations biologiques (cortège fongistique du bouleau, du charme, etc.), la synécologie du groupement (description du mycotope), le rythme saisonnier et la distribution géographique.

Il est intéressant de remarquer enfin que la méthode de DARIMONT permet la vérification de l'a priori d'homogénéité posé lors de la délimitation préliminaire des mycotopes. En effet la méthode a démontré l'homogénéité des mycotopes choisis à l'exception d'un seul, hétérogène, et a prouvé l'identité de deux autres.

En conclusion, on peut croire que DARIMONT sera pour les mycosociologues celui qu'est devenu BRAUN-BLANQUET pour les phytosociologues. Ce sont des principes et une méthode , mais aussi les premières constructions de l'édifice de la MYCOSOCIOLOGIE, science nouvelle, que le Professeur Fredi DARIMONT nous a léguées. A d'autres de continuer.

LES CHAMPIGNONS, par Uberto TOSCO et Annalaura FANELLI. Collection Spéciale Les Sciences, 80 p., 32 figs., 126 photos coul., 4° broché, 1974. Ed. Istituto Geografico de Agostini, Novara, Italia & Ed. Grange Batelière, 10 rue Chaudat, Paris. Prix FF 12.oo.

Il s'agit de la réimpression de l'ouvrage déjà paru sous le titre LA CUEILLETTE DES CHAMPIGNONS, volume 2 de la collection "Documentaires en couleurs" chez Grange Batelière, en 1969, en version française de l'édition italienne de 1968.

Les auteurs, mycologues du Bureau Sanitaire de Turin, illustrent 112 champignons comestibles et vénéneux, parmi les plus communs mais que tout amateur doit connaître. Les photographies, souvent en pleine page, sont de très bonne qualité, même si les champignons ne sont pas toujours photographiés en place. Le texte est bref et clair; la nomenclature latine est traditionnelle. Cet album est un cadeau à offrir, aussi agréable qu'utile.

CIUPERCI PYRENOMYCETES-SPHAERIALES DIN ROMÂNIA, par C. SANDU-VILLE, 409 p., 75 figs., 1971. Editura Academiei Republicii Socialiste România, Str. Gutenberg 3bis, Bucarest 6, România. Prix Lei 28.oo.

Liste descriptive de 620 espèces de l'ordre des "Sphaeriales" de Roumanie. L'ordre est compris au sens de Clements & Shear (1931). Seules les familles Sphaeriaceae, Hypocreaceae et Lophiostomataceae sont inventoriées. La clé des genres proposée est la traduction de celle de Clements & Shear. L'auteur n'ignore cependant pas l'existance des systèmes modernes de classification des Ascomycètes, distinguant les unituniqués des bituniqués, mais ne les accepte pas. Sa taxonomie est traditionnelle. Il réhabilite même Sphaerella Fr. (1849), invoquant sa priorité sur Mycosphaerella Joh., alors que ce nom est homonyme de Sphaerella Sommerf. (1824, = Protococcus Agdh.). Il y établit 7 combinaisons nouvelles. L'auteur décrit aussi 5 espèces et 1 variété nouvelles dans les genres Physalospora, Pleosphaerulina, Didymella, Metasphaeria, Leptosphaeria et fait une nouvelle combinaison dans Hercospora.

SEPTORIOZELE DIN ROMÂNIA, par E. RADULESCU, A. NEGRU et E. DOCEA, 325 p., 60 figs., 1973. Editura Academiei Republicii Socialiste România, Str. Gutenberg 3bis, Bucarest 6, România. Prix Lei 21.5o.

Une liste descriptive de près de 400 espèces de Septoria de Roumanie, arrangée suivant la taxonomie de la plante-hôte. Conforme à la tradition de Saccardo, la diagnose du genre et des espèces se base essentiellement sur la forme et la dimension des pycnides et des conidies, la septation des conidies et les symptômes de l'hôte, mais ignore complètement les caractères morphogénétiques de la conidiogénèse qui servent depuis 20 ans à la taxonomie des Sphaeropsidales. Le livre reste néanmoins un document pour la flore mycétique de Roumanie.

THE BIOLOGY OF LICHENS, par Mason E. HALE. Collection Contemporary Biology, 2e ed., 181 p., ill., 1974. Edward Arnold, 25 Hill str., London W1X 8LL. Prix £ 3.oo.

Il n'est pas étonnant qu'une introduction de cette qualité à la biologie des lichens ait été rapidement épuisée. La réédition a permis à l'auteur de mettre à jour le texte sur la base de 52 références bibliographiques nouvelles et d'inclure des aperçus sur la structure fine et la sociologie des lichens, tout en restant dans les limites de la pagination originale.

IMPROVING THE DISSEMINATION OF SCIENTIFIC AND TECHNICAL INFORMATION: A PRACTITIONER'S GUIDE TO INNOVATION, préparé par le CAPITAL SYSTEMS GROUP INC. for the Office of Science Information Service, National Science Foundation, U.S.A., 143 p., 4°, en reliure mobile, 1975. Distribué par National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, U.S.A. Prix US $ 10.25 ou en microfiches 3.75.

Cette publication ne traite pas de mycologie mais de technique dediffusion. C'est un guide à recommander à tous les intéressés et les responsables de la diffusion de l'information scientifique. Son but est de proposer, dans ou endehors des systèmes traditionnels d'édition, les idées nouvelles susceptibles d'encourager la diffusion la plus rapide, la plus large et la plus économique de l'information scientifique et de stimuler l'étude et l'essai de moyens nouveaux. Par exemple, la première des cent innovations proposées est le "manuscrit d'auteur prêt à la reproduction". Ce procédé - qui a été adopté par MYCOTAXON - est de plus en plus utilisé . Les avantages et les inconvénients de chaque innovation sont impartiallement exposés et discutés afin de permettre à chacun de prendre position et,s'il le veut, d'appliquer les conseils qui sont donnés.

C'est la boîtes aux idées, à laquelle d'ailleurs le lecteur est invité à contribuer en communiquant ses propres idées et expériences bonnes et mauvaises. En effet les éditeurs projeent de continuer la publication du Guide par des additions régulières.

LICHENS, par Annie Lorrain SMITH, Cambridge University Press, 1921, xxviii + 464 p., 135 figs., réimprimé par The Richmond Publishing Co., Richmond, Surrey, England, avec intoduction et index par D. HAWKSWORTH, 1975. Prix £ 11.5o.

Cette réimpression du livre de Annie Lorrain SMITH, le meilleur livre de l'époque sur la lichénologie, est bienvenue. Le livre comprend une histoire de la lichénologie (20 p.), un texte très complet pour l'époque sur l'anatomie et la biologie des lichens (280 p.), un exposé unique des familles et genres de lichens du monde entier (37 p.) et enfin un essai sur l'écologie et la sociologie des lichens (40 p.). Dans une introduction, D. HAWKSWORTH rapelle la vie de l'auteur et propose une liste de la littérature récente qui complètera l'ouvrage et une liste des noms corrigés de lichens.

THE FILAMENTOUS FUNGI. VOL. I. INDUSTRIAL MYCOLOGY, édité par John E. SMITH et David R. BERRY, 340 p., ill., relié toilé, 1975. Edward Arnold Publ., 25 Hill str.,London W1X 8 LL. Prix £ 12.5o.

Il y a 7 ans sortait chez Arnold la sixième et dernière édition de AN INTRODUCTION TO INDUSTRIAL MYCOLOGY par G. SMITH. Cet ouvrage introductif a aidé et aidera encore de nombreux enseignants, chercheurs et industriels à se familiariser avec les champignons d'importance industrielle et les techniques de leur étude.

Aujourd'hui se fait sentir le besoin d'un ouvrage plus complet sur les connaissances actuelles en la matière. Le fait que des ouvrages récents (non cités) on été consacrés aux levures et à leurs activités biologiques, alors que les champignons filamenteux, selon les auteurs, ont été délaissés, est la raison pour laquelle les auteurs ont limités leur entreprise aux seuls champignons filamenteux.

Le Volume I, intitulé INDUSTRIAL MYCOLOGY, est une revue en 16 chapitres de différents auteurs du rôle des champignons filamenteux dans l'industrie biologique et alimentaire. Cela va de l'écologie du développement, la cinétique de la croissance, la formation de biomasse et les activités de fermentation aux multiples productions de métabolites secondaires, d'antibiotiques, d'acides organiques, d'enzymes, de substances organoleptiques, de substances pharmaceutiques, de protéines et même aux productions alimentaires comme telles, aliments fermentés à l'orientale et champignons comestibles. Il aborde aussi la biodétérioration des matériaux, la biodégradation des déchets et la formation de mycotoxines dans les aliments.

L'ouvrage est bien édité: on y reconnaît la qualité des éditions Arnold. Le style des auteurs est clair, concis, scientifique et didactique à la fois. Certains chapitres sont remarquablement informateurs. Par contre, d'autres restent brefs ou superficiels. On ne trouve pas, par ex., référence à l'ouvrage classique de Cl. Moreau sur les Mycotoxines. Le chapitre sur la biodétérioration n'est documenté que de 25 références très générales.

La coupure champignons filamenteux/levures comme l'exclusion de celles-ci dans le but de limiter le programme est discutable et sans doute regrettable. Elle nous enlèvera le bénéfice de la comparaison de l'activité des uns et des autres. D'autre part, à considérer le programme qui couvrira la biosynthèse et le métabolisme (vol. 2), la structure cellulaire, l'écologie, la génétique et la taxonomie des champignons filamenteux, on se demande à quel point ce traité fera-t-il double emploi avec d'autres, THE FUNGI p. ex., tout en restant amputé d'une partie difficilement dissociable de la mycologie industrielle, les levures.

Néanmoins, par tout ce qu'il nous offre dans son premier volume, cet ouvrage est déjà d'un grand intérêt et d'une utilité certaine.

MYCOGENETICS, AN INTRODUCTION TO THE GENERAL GENETICS OF FUNGI, par J. H. BURNETT, 375 p., ill., relié, 1975. John Wiley & Sons, Baffins Lane, Chichester, Sussex PO19 1UD, England. Prix £ 27.50.

Constatant que "beaucoup de mycologues, de phytopathologues et d'utilisateurs industriels des champignons ont une connaissance limitée de la génétique des champignons ... et que beaucoup de généticiens ignorent les ressources que leur offrent les champignons" l'auteur nous présente ce livre comme une "introduction" où il "décrit la génétique des champignons en insistant sur les lacunes et les problèmes des connaissances actuelles plutôt que sur le détail des dernières découvertes".

Le livre se divise en 4 parties. La première partie, l'Introduction, initie le généticien à la mycologie (Fungi as organisms for genetic studies). La seconde partie (125 p.) résume les données de la génétique formelle des champignons (genetic markers; meiotic, mitotic, karyotic and somatic recombination, segregation and linkage; quatitative inheritance). La troisième partie (80 p.) concerne la génétique des populations (variation, mutation, mating systems, natural selection, genetic polymorphism, stability, isolation mechanisms). La quatrieme partie (85 p.) considère les domaines où s'utilise la génétique des champignons (industry, plant pathology, genetical research).

Le généticien averti trouvera dans ce livre un support étonnant à l'orientation de ses recherches dans des voies mycologiques. Mais l'auteur n'aura touché que la moitié de son audience. En effet le généticien est bien introduit à la mycologie, mais le mycologue sera déçu de ne pas l'être à la génétique au cours de l'introduction, car de la seconde partie à la fin du livre, le style et le vocabulaire ésotérique, propre à la génétique, sera totalement hermétique à sa compréhension. "Complementation", "protrophic phenotype","homomixis", "diaphoromixis", "interchange suppressor", "super-suppressor", etc. sont autant d'énigmes pour le non-initié. Il eut fallu dans la première partie un chapitre destiné au mycologue, intitulé "Fundamentals of genetics, as applied to the fungi".

BIODEGRADATION ET HUMIFICATION, RAPPORT DU Ier COLLOQUE INTERNATIONAL, NANCY, 1974, édité par Gérard KILBERTUS, Otto REISINGER, André MOURET et J.A. CANCELA DA FONSECA, 496 p., 1975. Ed. Pierron, 57206 Sarreguemines, France. Prix FF 130.00.

Bien que l'intention des organisateurs était de se limiter à la relation organismes biodégradants/formation de l'humus, le titre du Symposium a ouvert la porte à un éventail très large de communications. Ce fait et l'absence de regroupement des articles par sujet engendrent chez le lecteur une impression d'hétérogénéité et de désordre.

Nombreux sont les articles devant intéresser les écologistes, les microbiologistes et biochimistes du sol. Pour sa part, le mycologue trouvera satisfaction dans les études de la mycoflore de la litière forestière (J.C. FRANCKLAND), de litière fraîche de *Populus tremuloides* (S. VISSER & D. PARKINSON), de grains d'orge (A.E. APINIS), de *Phragmites communis* (A.E. APINIS & H.K. TALIGOOLA), de feuilles d'*Ulex europaea* (R.N. STRINGER), d'aiguilles de *Pinus sylvestris* arrosées ou non d'urée (P.F. LEHMAN) et enfin... de la mycoflore de l'ambre (J. NICOT). Trois articles traitent encore de la dégradation de la cellulose et de la lignine par les champignons saprophytes (H.J. HUDSON), par *Drechslera sorokiniana* (G.T. COLE) et par *Armillariella mellea* (K. RYKOWSKI).

COELOMYCETES V. CORYNEUM, par B. C. SUTTON, C.M.I. Mycological Papers, no. 138, 224 p., 84 figs., 2 pls., 1975. Commonwealth Agricultural Bureaux, Farnham Royal, Slough SL2 3BN, England. Prix £ 6.oo.

Le genre *Coryneum* avec ses 182 taxa décrits est entièrement revu. 20 taxa seulement sont retenus, dont 3 nouvelles espèces, 1 nouvelle variété et 3 recombinaisons. 116 noms sont exclus de *Coryneum*, réduits en synonymie ou recombinés dans *Apocoryneum*, genre nouveau, ou les genres *Seimatosporium*, *Seiridium*, *Stigmina*, *Colletogloeum*, *Stilbospora* et 28 autres encore. 45 autres taxa, en l'absence de type, sont exclus sur la base des descriptions.

Les caractères conidiens suffisent, dans *Coryneum*, à la diagnose des 20 espèces et variété et sont le plus souvent les seuls figurés. Le lecteur aurait certainement apprécié des illustrations plus complètes de chaque espèce, incluant aussi les conidiophores et acervuli, comme les bonnes illustrations de beaucoup d'espèces à exclure, telles *Seimatosporium pezizoides* ou *Stilbospora pistaciae*. Cette monographie du genre *Coryneum* est certainement la bienvenue, après 150 années de confusion.

ANTHOSTOMELLA SACC. (PART I), par Sheila M. FRANCIS, C.M.I. Mycological Papers, no. 139, 97 p., 29 figs., 1975. Commonwealth Agricultural Bureaux, Farnham Royal, Slough SL2 3BN, England. Prix £ 3.oo.

Première partie d'une revision des *Anthostomella*, limitée aux espèces d'Europe sur conifères et plantes herbacées. L'auteur rejette la lectotypification fautive du genre par Clements & Shear mais aussi celle de Eriksson (*A. limitata*) en raison de l'absence de matériel type et d'un doute taxonomique; elle choisit *A. tomicoides* comme lectotype. *Marinia*, *Myconeesia*, *Phaeophomatospora* sont synonymes, de même que *Paranthostomella* Speg. après le rejet - peut-être discutable - du lectotype de von Höhnel qui en faisait un genre distinct. 32 taxa sont décrits, dont 2 nouvelles espèces et 2 recombinaisons; 2 genres et 30 espèces sont exclues ou considérées comme douteuses.

THE PYRENOMYCETOUS FUNGI, par Lewis E. WEHMEYER, Mycologia Memoir no. 6, 250 p., relié, 1975. The New York Botanical Garden, The Mycological Society of America, J. Cramer ed., D-3301 Lehre, Allemagne. Prix DM 80.-, MSA members: US $ 20.-

Dernière ouvre de l'auteur, que le Dr. Richard T. Hanlin a soignesement préparé à la publication et qui couronne une vie consacrée aux ascomycètes par un nouvel essai de systématique des Pyrénomycètes.

L'auteur a recherché un compromis susceptible de concilier les options taxonomiques modernes. Sa classification des Ascomycètes et la place des Pyrénomycètes se résument comme suit. Deux sous-classes, les Protoascomycètes (Endomycetales, Hemiascales et Taphrinales) et les Carpoascomycètes qu'il subdivise en Discomycètes (qu'il ne traite pas) et Pyrénomycètes. Ce sont ceux-ci qu'il subdivise en Loculoascomycètes (bitunicatae: Microthyriales, Hysteriales, Dothideales, Pleosporales) et en Euascomycètes (unitunicatae: Plectascales, Melanosporales, Xylariales, Allantosphaeriales, Diaporthales, Hypocreales, Laboulbeniales, Clavicipetales, Erysiphales et Sphaeriales). Dans chaque ordre, familles et genres sont données avec clés, caractères, affinités et références bibliographiques.

Même si l'arrangement taxonomique peut ne pas trouver l'agrément général, ce travail restera cependant un heureux essai de synthèse, un manuel didactique très utile et une bonne source d'information.

ICONES MICROFUNGORUM A MATSUSHIMA LECTORUM, par Takashi MATSUSHIMA, 209 p., 415 pls., 1975. Edité par l'auteur, Matsushima Fungus Collection, 601, Mikage Corporouse, 48 Tenjinyama, Nishihirano, Mikage-cho, Higashinada-ku, Kobe City, Japan 658. Prix non indiqué.

Après un premier ouvrage de l'auteur, MICROFUNGI OF THE SOLOMON ISLANDS AND PAPUA-NEW GUINEA (1971), recensé dans MYCOTAXON, 1:64, 1974, en voici un second et de la même haute qualité.

Le texte comprend la description, sans commentaire, de 655 microfungi, en provenance du Japon et de l'Alaska, récoltés et isolés en culture pure par l'auteur: 577 Deuteromycètes (dont 170 espèces nouvelles et 17 recombinaisons), 65 Ascomycètes (dont 2 nouveaux) et 13 Phycomycètes (Mucorales). Sept genres nouveaux d'Hyphomycètes sont décritz: Beauveriphora, Biflagellospora, Calceispora, Hyalosynnema, Lappodochium, Phialoarthrobotryum et Triramulispora.

Les espèces sont disposées par ordre alphabétique dans leur classe. Toutes sont illustrées, sauf 8 qui ne le sont pas et 15 qui l'ont été en 1971 par l'auteur. Si la recherche d'une description d'espèce est aisée, celle de son illustration ne l'est pas. La disposition compacte des figures de plusieurs espèces par planche, sans légende sur les planches (celles-la étant groupées dans une liste de 19 pages) et l'ordre taxonomique des planches différant de celui des descriptions rendent l'usage des planches très malaisé. Mais ce défaut est purement éditorial.

L'auteur fait preuve d'une parfaite maîtrise de sa technique mycologique. Ses illustrations sont surprenantes par leur qualité. Pour réaliser ses microphotographies, l'auteur a disposé conidiophores et conidies sur un mince film d'agar par micromanipulation!

L'abondance des espèces nouvelles est aussi étonnante. On doit reconnaître à la fois les connaissances mycologiques étendues de l'auteur et sa prudence à dénommer ses trouvailles, puisque 70 des 655 espèces décrites restent sans nom. On se plairait alors à imaginer les terres explorées par l'auteur comme autant de paradis pour le mycologue. C'est possible, mais nous croyons surtout dans la perspicacité du mycologue.

Tel est cet ouvrage qui, comme le précédent, est un témoignage de la valeur de son auteur et un document mycologique dont on ne pourra se passer dans l'étude des micromycètes.

FUNGI OF INDIA. SUPPLEMENT TO THE LIST OF INDIAN FUNGI, 1962-1972, Par K. G. MUKERJI et R. C. JUNEJA, vi + 224 p., 1 carte relié, 4°, 1975 (date indiquée sur la couverture mobile; le livre est non daté, mais sa préface datée du 24 décembre1974) Emkay Publications, B-19 East Krishma Nagar Extension, Delhi 110051, India. Prix US $ 15.oo, UK £ 6.oo.

Cette liste est le cinquième supplémentà la liste THE FUNGI OF INDIA de E. J. Butler et G.R. Bisby (jusqu'à 1930) après les quatre premier suppléments par B.B. Mundkur (1931-1938), K. Ramakrishnan et C. V. Subramanian (1938-1951), C. V. Subramanian et K. Ramakrishnan (1952-1956) et R. N. Tandon et S. Chandra(1957-1962). Ce cinquième supplément répertorie 3435 noms d'espèces publiés de 1962 à 1972.

Il est heureux que cet index des champignons de l'Inde soit ainsi continué grâce au dynamisme des mycologues indiens. On regrettera peut-être qu'ils n'ont pas groupés les genres par classe comme dans les volumes précédents. Cette disposition eut aidé la recherche des champignons d'une même classe et la comparaison avec les volumes précédents, sans compter l'épargne de quelques 900 lignes typographiques.

FUNGI. BASIDIOMYCETES. BOLETALES (Grzyby. Podstawczaki, Borowikowe), par Alina SKIRGIEŁŁO, 1960, version revisée 1975 traduite du polonais en anglais par A. Radziwiłł, 132 p., 51 figs., 30 pls. cols., toilé, Warsaw, 1975. Distribué par U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia 22161, USA (Document TT-54039). Prix non indiqué.

Après la parution des traductions des volumes 2 et 3 de la même série polonaise FUNGI (Grzyby), qui traitaient des Polyporés et familles voisines par Stanislas Domański, il est agréable de présenter la traduction d'une version corrigée du premier volume. La qualité de l'édition est excellente. L'ouvrage est de niveau scientifique et l'amateur y est introduit par un chapitre préliminaire et aidé d'un lexique terminologique.

L'auteur décrit 52 espèces et 26 variétés et formes existant en Pologne, 5 autres probables et 5 encore mais douteuses. Elle crée 18 combinaisons nouvelles de formes et variétés dans Boletus rubellus, B. edulis, Leccinum aurantiacum et L. scabrum.

L'ouvrage est rehaussé de très belles aquarelles dépeignant 35 espèces et 12 variétés.

Deux 'lapsus' de nomenclature ont été trouvés: Boletus rubellus "var. versicolor" (p.73) doit sans doute se lire "var. rubellus" et Leccinum scabrum "f. rotundifoliae" sans doute se lire "f. rotundifoliae (Sing.) comb. nov."(p.94).

LES CHAMPIGNONS COMESTIBLES ET VENENEUX, par † André MAUBLANC 6e édition revue par G. VIENNOT-BOURGIN (1971), Encyclopédie pratique du Naturaliste, vol. 22: TOME I. TEXTE GENERAL, vi + 305 p., vol. 23: TOME II. ATLAS, 279 p., 226 pls. cols., 16°, toilé, 2e tirage daté "1974" (sorti le 17 septembre 1975). Ed. Lechevalier, 19 rue Augereau, 75007 Paris. Prix FF 150.oo.

Le "MAUBLANC" est certainement l'ouvrage sur les champignons le plus vendu à travers le monde, puisque, à l'épuisement du présent tirage 1975 prévu pour cet été 1976, 100.000 exemplaires auront été vendus depuis la première édition. Les quatre premières éditions parurent en 1921, 1926-27, 1939 et 1952 sous la responsabilité de l'auteur et avec les deux titres CHAMPIGNONS DE FRANCE en couverture et LES CHAMPIGNONS COMESTIBLES ET VENENEUX en page de tête. C'est le second titre qui fut seul retenu pour la 5e édition revue par G. VIENNOT-BOURGIN en 1959. La 6e édition ne diffère de la précédente que par l'addition de la description et des aquarelles de deux espèces vénéneuses mortelles.

Ce qui a garanti à l'ouvrage un tel succès, c'est d'abord la clarté et la précision des clés et des descriptions incluant aussi des caractères microscopiques et des commentaires taxonomiques, mais aussi l'excellente qualité des planches en couleurs représentant avec grande véracité les formes et couleurs les plus caractéristiques des champignons et de leurs spores. 177 des 226 planches sont les aquarelles originales de Juliette Boully qui, au nombre de 185, ont illustré l'ouvrage depuis sa 2e édition. Trois d'entre elles représentant les Amanites blanches ont malheureusement été remplacées par des photographies en blanc-noir; de même cinq autres ont été substituées par des aquarelles récentes. 7 aquarelles sont de P. Konrad (non cité dans cette édition), 30 sont de F. Porchet (depuis la 3e édition) et 11, plus récentes et d'une autre qualité, de A. Bertaux et H. Essette. L'éditeur a cherché à maintenir l'exactitude des couleurs et y a assez souvent réussi.

La revision du texte, lors de la 5e édition en 1959, a essentiellement porté sur la nomenclature: 35 noms des 321 espèces ont alors été mis à jour, les autres restant inchangés depuis les premières éditions de 1921, 1926 ou 1939. Si l'on sait que plus de 80 autres noms devraient encore être revisés pour s'accorder avec la taxonomie moderne, on verra combien la nomenclature de ce livre est restée traditionnelle. Ce ne serait encore qu'un demi mal. Mais plus de 220 citations d'auteurs des espèces illustrées et l'orthographe d'une dizaine d'épithètes (sans compter encore les nombreux synonymes et autres espèces citées dans le texte) sont incorrectes. Ceci est d'autant plus regrettable que ce livre si attrayant est, du fait de sa grande diffusion, un moyen inestimable de formation à cette science en progrès constant qu'est la mycologie. D'ailleurs ce serait se tromper que de croire le mycologue amateur ou débutant rebuté par la modification du nom des champignons; surtout s'il est aidé d'une synonymie correcte lui rappelant l'ancienne dénomination, son désir d'ajuster toujours ses connaissances lui fera vite surmonter la difficulté. On voudrait espérer que lors du tirage prochain de ce livre, les noms adoptés soient correctement cités et qu'une liste de correspondance avec la nomenclature d'aujourd'hui puisse y être ajoutée. Ce serait donner à l'ouvrage la qualité scientifique qu'il mérite et que le lecteur en attend.

DIE TERRESTRISCHEN STACHELPILZE EUROPAS. THE TERRESTRIAL HYDNUMS OF EUROPE, par R. A. MAAS GEESTERANUS. Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, Afd. Natuurkunde, 2e série, vol. 65, 126 p., 58 figs., 40 pls. (aquarelles par J. H. VAN OS et R. A. MAAS GEESTERANUS), broché, 1975. North Holland Publishing Co., Amsterdam, Prix Dfl 85.oo.

Cette monographie des Hydnums stipités terricoles d'Europe fournit la description de 42 espèces d'*Auriscalpium*, *Bankera*, *Phellodon*, *Sistotrema*, *Hydnum*, *Hydnellum* et *Sarcodon*, sur la base de l'étude des types, de relevés de terrains et d'études anatomiques.

L'auteur a eu l'heureuse idée de présenter la partie taxonomique de l'ouvrage ainsi que les clés d'identification dans les deux langues allemande et anglaise, afin d'aider le plus grand nombre de lecteurs.

L'illustration du texte consiste presque exclusivement dans des dessins de spores. On n'y trouvera pas l'illustration des structures microscopiques de l'hyménium et de la chair dont il est parlé dans les clés et les descriptions. Par contre, on admirera les très belles aquarelles représentant 40 des espèces décrites.

Cinq espèces, *Hydnellum tardum*, *H. coalitum*, *Sarcodon cyrneus*, *S. lepidus* et *S. regalis*, sont nouvelles; de même, 3 sections du genre *Hydnellum* et une section de *Sarcodon*. Une espèce de *Sarcodon* reste sans nom.

Par la qualité du texte et la beauté de son illustration, ce livre, comme le précédent du même auteur, HYDNACEOUS FUNGI IN THE EASTERN WORLD, s'affirme de grande valeur.

THE BIRD'S NEST FUNGI, par Harold J. BRODIE, 200 p., 64 figs., relié toilé, 1975. University of Toronto Press, Toronto, Canada M5S 1A6; 33 East Tupper street, Buffalo, NY 14203,USA. Prix US $ 25.oo.

Oeuvre de toute une vie, the BIRD'S NEST FUNGI est plus qu'une revision de cinq genres de Nidulariaceae, *Cyathus*, *Crucibulum*, *Mycocalia*, *Nidula* et *Nidularia*, au total 61 espèces et 1 forme (dont 11 espèces et 1 forme de l'auteur). C'est une monographie au plein sens du mot, où l'auteur s'attache avec autant d'ingéniosité que de science à préciser la biologie de ces champignons et leur mode de croissance, de fructification et de dispersion sur la base d'observations de terrain et d'expérimentations inédites sur cultures de laboratoire.

La plupart des espèces étudiées par l'auteur ont été obtenues en culture à partir des basidiospores, malgré la difficulté d'induire leur germination. Le comportement cultural et sexuel des homocaryons et des dicaryons et la production de fructifications dans des conditions contrôlées ont permis à l'auteur de définir le type sexuel de 11 espèces: toutes tétrapolaires à l'exception de 2. *Mycocalia denudata*, bipolaire hétérothalle et homothalle facultative et *M. duriaeana* homothalle.

L'énigmatique mécanisme de la dispersion des péridioles a passionné l'auteur, à l'exemple de Tulasne. Par de multiples observations et expériences, l'auteur a démontré qu'une goutte d'eau, à la vitesse de chute de 4 à 8 m/sec., est capable d'éjecter avec force les péridioles hors de la coupe en brisant la gaine du funicule et libérant le harpon d'hyphes adhésives qui termine le cordon funiculaire empaqueté dans la gaine. Le harpon s'accrochera au premier support rencontré et la péridiole retenue par le cordon y restera attachée. Une merveille de la nature qu'il nous est donné de découvrir avec l'enthousiasme de l'auteur.

Le livre est excellemment conçu et édité, abondamment illustré de dessins, de photographies et aussi d'humour.

ZUR ÖKOLOGIE DER PORLINGE. UNTERSUCHUNGEN UBER DIE SPORULATION EINIGER PORLINGE UND DIE AN IHNEN GEFUNDENEN KÄFERARTEN, par Ingo NUSS, Bibliotheca Mycologica, vol. 45, 258 p., 62 figs., 36 tab., broché, 1975. J. Cramer, FL-9490 Vaduz, Liechtenstein. Prix DM 50.oo.

L'ouvrage comporte deux pôles d'intérêt distincts mais relatifs de l'écologie des Polypores, l'écologie de la sporulation et l'incidence des insectes.

Par des observations sur 86 carpophores en place de 27 espèces de Polypores, répétées chaque semaine durant deux ans, l'auteur met en évidence la périodicité saisonnière de la sporulation, la fréquence des arrêts de sporulation, la durée de la sporulation en rapport avec la longévité et la vitesse de croissance des carpophores, l'influence des conditions climatiques (humidité relative et température de l'air) sur le rythme, le départ et la durée de la sporulation et enfin les rythme journaliers de libération des spores. Il examine aussi la relation entre le rythme de la sporulation et les variations dans la forme et les dimensions des basidiospores. Ces observations très nombreuses, précises et statistiques sont finalement formulées en principes et aboutissent à une classification écologique des espèces étudiées. En plus de cela, l'auteur fait une revue fouillée de toutes les connaissances acquises en la matière .

Ensuite, l'auteur relate ses observations sur l'incidence des coléoptères dans les carpophores, en relation avec l'espèce, le développement et la sporulation de ceux-ci. 153 espèces appartenant à 28 familles de coléoptères ont été relevées en un an sur 20 espèces de Polypores. Les Staphylinidae sont les mieux représentés et _Laetiporus sulphureus_ et _Polyporus squamosus_ sont les plus habités. L'auteur étudie aussi la nutrition des insectes mycophages et son rôle dans la dissémination des spores.

Ce livre contribue indiscutablement à l'avancement de l'écologie des basidiomycètes. Il apporte aussi d'intéressantes données sur la relation faune-fonge qui dans les biocénoses joue souvent un rôle important.

WOOD-INHABITING FUNGI OF ALDER FOREST IN NORTH-CENTRAL SCANDINAVIA. I. APHYLLOPHORALES (BASIDIOMYCETES). TAXONOMY, ECOLOGY AND DISTRIBUTION, par Åke STRID, Wahlembergia, Scripta Botanica Umensia, Prof. Bengt PETTERSSON édit., vol. 1, 237 p., 219 figs., 1975. University of Umeå, Department of Ecological Botany, S-90187 Umeå, Sweden. Prix Skr 45.oo, US $ 10.oo.

WAHLEMBERGIA est un nouveau périodique publié par le Département de Botanique et d'Ecologie de l'Université de Umeå, paraissant à intervale irrégulier. Chaque volume consiste en une monographie ou plusieurs travaux originaux dans les domaines de l'écologie et de la botanique systématique. Ce journal, auquel nous souhaitons la bienvenue, a consacré son premier volume à l'écologie des champignons. Les volumes 2 (1975) et 3 (1976) traitent d'écologie végétale. Le journal est vendu par volume ou par souscription.

Dans ce volume, STRID répertorie la flore des champignons lignicoles des forêts littorales et riveraines à Alnus glutinosa et A. incana du Nord et du Centre de la Suède et de la Norvège. Il en analyse alors la distribution et les caractéristiques écologiques. Cinq mille récoltes d'Aphyllophorales dans une centaine de localités ont mis en évidence 286 espèces, dont 6 non encore identifiées. Quatre recombinaisons sont proposées dans Hypochnicium, Phlebia et Systotrema.

THE CORTICIACEAE OF NORTH EUROPE, par John ERIKSSON et Leif RYVARDEN. VOL. I. (texte, clés, glossaire et index), p.1-59, figs. 1-20, (en préparation); VOL. II. ALEURODISCUS - CONFERTOBASIDIUM, p. 60-286, figs. 21-110, 24 pls., 1973; VOL. III. CORONICIUM - HYPHODERMA, p. 287-546, figs. 111-256, 1975; broché. Editions Fungiflora, Blindernveien 46C, Oslo-3, Norvège. Prix vol. 2: Nkr 54.oo, US $ 9.oo; vol. 3: Nkr 70.oo US $ 12.oo.

Les excellents dessins de John ERIKSSON, accompagnés de nombreuses photographies, illustrent un texte clair et précis et placent cette flore des Corticiaceae du Nord de l'Europe parmi les meilleurs ouvrages sur cette famille. L'intention de l'auteur est de présenter, avec une nomenclature correcte, des descriptions d'espèces permettant leur diagnose. Traité dans un ordre alphabétique, chaque genre est décrit et accompagné d'une clé des espèces. Chaque espèce est abondamment illustrée. 43 genres sont traités dans les volumes II et III; 3 genres sont nouveaux: Ceraceomerulius (3 espèces), Coronicium (1 espèce) et Fibriciellum (1 espèce). 143 espèces sont décrites, 9 sont nouvelles et 16 recombinées.

L'entreprise de cette flore, avec de telles qualités, est hardie, mais l'auteur la réussit. Plusieurs volumes sur la partie taxonomique devront encore paraître avant que le premier volume ne soit publié. Un ouvrage qui s'impose et est à suivre.

THE POLYPORACEAE OF NORTH EUROPE. VOL. I. ALBATRELLUS - INCRUSTOPORIA, par Leif RYVARDEN, 214 p., 87 figs., 1976. Editions Fungiflora, Blindernveien 46C, Oslo-3, Norvège. Prix Nkr 75.oo.

Ce volume est le premier de deux, devant couvrir tous les champignons poroîdes connus de l'auteur dans la moitié septentrionale de l'Europe, y compris l'Angleterre et les Pays-Bas. Au début de ce volume une clé des 49 genres à traiter est donnée. Ce volume décrit 76 espèces dans 28 genres de Albatrellus à Incrustoporia. L'illustration est abondante. Comme les autres publications de Fungiflora, cette flore est à la portée de tous, didactique et de qualité.

AN INDEX OF THE COMMON FUNGI OF NORTH AMERICA (SYNONYMY AND COMMON NAMES), par Orson K. MILLER et David F. FARR. Bibliotheca Mycologica, vol. 44, 206 p., broché, 1975. J. Cramer FL-9490 Vaduz, Liechtenstein. Prix DM 100.oo.

C'est une très heureuse initiative de mettre à jour la nomenclature des trente Guides des Champignons les plus utilisés aux Etats Unis et au Canada, depuis le MUSHROOMS AND THEIR USE de Charles H. Peck (1897) jusqu'au MUSHROOM POCKET FIELD GUIDE de H. E. Bigelow (1974) en passant par Atkinson, Güsson & Odell, etc.

Le livre consiste dans la liste des noms des 400 espèces publiées dans ces Guides, après correction conformément à la taxonomie et la nomenclature moderne. Les noms d'espèces sont disposés par genre avec l'indication des synonymes les plus usités et des noms vernaculaires anglais. Un index alphabétique des épithètes spécifiques permet de retrouver l'épithète correcte et son assignation générique.

L'utilité de cet index est évidente et sa nécessité indiscutable. Le mycologue amateur ou débutant se réjouira de le posséder. Le spécialiste aussi y trouvera un outil précieux, à condition de savoir que la référence aux auteurs préfriesiens a été omise dans un certain nombre de cas et que quelques rares erreurs typographiques subsistent.

On ne peut que recommander l'usage de ce livre et, grâce à lui, l'adoption d'une nomenclature moderne et correcte dans la publication de tout nouveau Guide des Champignons pour l'amateur.

A MONOGRAPHIC STUDY OF THE GENUS POUZARELLA, A NEW GENUS IN THE RHODOPHYLLACEAE, AGARICALES, BASIDIOMYCETES, par S. J. MAZZER. Bibliotheca Mycologica, vol. 46, 191 p., 85 figs., broché, 1976. J. Cramer, FL-9490 Vaduz, Liechtenstein. Prix DM 40.oo.

La reconnaissance de la section Induti dans le genre Rhodophyllus par Kühner et Romagnesi (1953) a constitué pour l'auteur le point de départ du concept générique Pouzarella Mazzer. L'auteur démontre que l'homogénéité du groupe s'affirme dans les affinités morphologiques des espèces et se retrouve dans son écologie confinée au bois en décomposition avancée ou l'humus qui en résulte, dans des forêts très humides de plaines marécageuses, à végétation mixte de conifères et de feuillus. L'auteur assigne au genre Pouzarella 31 espèces, dont 5 nouvelles, qu'il classe en trois sections, sect. Pouzarella (3 espèces), sect. Versatiles (11 espèces) et sect. Dysthales (17 espèces).

THE FUNGAL SPORE: FORM AND FUNCTION, édité par Darell J. WEBER et Wilford M. HESS, 865 p., illustr., relié toilé, 1976. John Wiley & Sons, Baffins Lane, Chichester, Sussex PO19 1UD, England. Prix £ 18.15, US $ 33.3o.

Communications originales présentées par 35 chercheurs au Second Symposium International sur la Spore fongique qui eut lieu à Brigham Young University, en 1974. Ce compte-rendu fait suite à celui du Premier Symposium de Bristol, édité par M.F. Madelin sous le titre THE FUNGUS SPORE (1966). Le premier symposium avait considéré la morphologie et la morphogenèse des spores. Le second étudie les variationset modifications de forme, de structure et de composition des spores durant la maturité, la dormance et la germination et étudie les mécanismes de ces trois états successifs pour mieux comprendre la fonction de la spore.

Contenu en bref: la dormance; inhibiteurs et activateurs de la germination; métabolisme des carbohydrates, lipides et protéines durant la germination; acides nucléiques et germination; changement des organelles durant la germination; relation forme-fonction chez les spores de chaque classe de champignons des Myxomycètes aux Deuteromycètes; spores fossiles.

Un fait transcende l'ensemble du livre: l'apport important de la microscopie électronique sur la structure fine de la spore et la genèse de ses parois.

RECENT ADVANCES IN AQUATIC MYCOLOGY, édité par E. B. GARETH JONES, 749 p., illust., relié toilé, 1976. Paul Elek Science, 54-58 Caledonian Road, London N1 9RN; Halsted Press, U.S.A. Prix £ 21.oo, US $ 49.5o.

Depuis trente ans, les champignons aquatiques ont beaucoup retenu l'attention des mycologues; aujourd'hui les écologistes s'y intéressent aussi. Sept Sections du Ier Congrès International de Mycologie à Exeter (1971) concernaient les champignons aquatiques marins et d'eaux douces. Là est née l'idée de ce livre.

Il se divise en 2 sections: l'une traite des champignons marins, l'autre des champignons d'eaux douces. Chaque section est divisée en deux sous-sections: (A) Ascomycètes, Basidiomycètes et Deuteromycètes et (B) Phycomycètes. Dans chaque sous-section, le lecteur trouvera plusieurs chapitres sur les caractères morphologiques et les affinités de ces champignons, un chapitre sur leur structure fine et leur composition, et plusieurs autres sur leur écologie, leur physiologie et leurs activités de pathogénie et de biodégradation.

Une très large information a été réunie dans ce volumineux ouvrage, recensée par 27 des meilleurs spécialistes, y compris le Dr. GARETH JONES lui-même. Celui-ci, en tant qu'éditeur, est aussi à féliciter pour l'attachante conception de l'ouvrage et l'harmonie de ses parties. Son livre n'est pas une pure compilation, mais une synthèse de connaissances, ouverte vers des recherches futures.

Le livre n'a pas été non plus une revue systématique exhaustive des champignons aquatiques; le taxonomiste y trouvera cependant des chapitres remarquables sur les Phycomycètes marins (T.W. JOHNSON), les Plasmodiophoromycètes et Oomycètes marins (F. K. SPARROW), les Phycomycètes uniflagellés et leur milieu (C.E. MILLER) les levures océaniques (J.N. TELL), la relation forme-fonction chez les Ascomycètes et Fungi Imperfecti d'eaux douces (C.T. INGOLD)et les Trichomycètes (R.W. LICHTWARDT).

Tout mycologue soucieux de connaître la vie fongique dans l'eau de notre planète devra ouvrir ce livre.

ON MUCOR CIRCINELLOIDES, MUCOR RACEMOSUS AND RELATED SPECIES, par M. A. SCHIPPER. Studies in Mycology, no. 12, 40 p., 13 figs., 1 pl., 1976. Centraalbureau voor Schimmelcultures, Baarn, Pays-Bas. Prix Dfl 15.oo.

Après ses études précédentes des groupes *hiemalis* (1973), *mucedo* et *flavus* (1975) (voir Mycotaxon 3(3):486, 1976), l'auteur analyse cette fois le groupe *circinelloides* (*Mucor circinelloides* avec 4 formes, *M. ramosissimus*, *M. bainieri* et *M. zonatus*) et le groupe *racemosus* (*M. racemosus* avec 3 formes, *M. plumbeus* et *M. fuscus*).

Cette revision taxonomique est basée sur l'étude de souches vivantes, types et autres, et leur interfertilité. Les formes de *Mucor circinelloides*, qui étaient considérées comme espèces, sont interfertiles, de même les formes de *M. racemosus*. Les appariements de ces deux espèces entre elles et avec *M. plumbeus* n'engendrent que des zygospores stériles.

Cette étude démontre clairement la grande variabilité morphologique de certaines espèces ou de certaines souches, en fonction de la température, de la lumière et du substrat. Cependant l'auteur arrive à présenter une bonne clé d'identification de ces espèces.

A MONOGRAPH OF CHALARA AND ALLIED GENERA, par T. R. NAG RAJ et W. B. KENDRICK, 200 p., 61 figs., relié toilé, 1975. Wilfrid Laurier University Press, Waterlo, Ontario N2L 3C5, Canada. Prix Can $ 9.oo.

Les auteurs présentent une révision taxonomique du genre hyphomycète Chalara, monomorphique, auquel ils assimilent les deux genres pléomorphiques Thielaviopsis (syn. Hughesiella et Stilbochalara) et Chalariopsis dont ils considèrent les noms comme synonymes, de même que ceux de Cylindrocephalum et Excioconidium.

Le concept générique Chalara est dès lors considérablement élargi par l'entrée de 8 espèces dimorphiques produisant, en plus des phialoconidies, des conidies holoblastiques et thalliques que les auteurs appellent "chlamydospores" les considérant comme secondaires ou de valeur marginale. Sans vouloir ériger en principe la ségrégation générique des espèces pléomorphiques sur la base de leur pléomorphisme, on peut cependant s'interroger sur la signification de ce pléomorphisme et des caractères culturaux particuliers de ces espèces du point de vue de l'affinité de ces espèces avec le reste du genre.

L'option nomenclaturale des auteurs est intéressante à considérer en face des problèmes d'interprétation de l'article 59 du Code International de Nomenclature . Selon cet article, comme on sait, l'application de l'épithète spécifique et du nom générique est, chez les champignons imparfaits, limitée à la seule forme imparfaite. S'il y a plusieurs formes imparfaites chez le même champignon, la question est de savoir si le nom générique et l'épithète spécifique auront une application globale (comme en toute bonne nomenclature botanique) couvrant donc toutes les formes conidiennes associées, ou s'ils auront une application particulière, ne couvrant qu'une seule forme conidienne ou partie anatomique du champignon, ou enfin l'épithète spécifique aura-t-elle une application globale à l'espèce tandis que le nom générique n'aurait qu'une portée anatomique c'est-à-dire qu'il n'indiquerait que l' appartenance de l'espèce à un groupe anatomique? Là subsiste le doute. Mais déjà trois systèmes nomenclaturaux peuvent se concevoir et ont déjà été appliqués de manière plus ou moins évidente dans la littérature sur les Fungi Imperfecti.

Dans le présent travail, l'option des auteurs n'est pas suffisament explicitée; des doutes subsistent. Il semble que leur intention est d'adopter une nomenclature "botanique" de l'article 59 du Code, puisqu'il rejette comme inadmissible une nomenclature purement anatomique et critique le système intermédiaire anatomico-botanique parce qu'il laisserait place à "a multiplicity of state-generic names" pour désigner les formes conidiennes alors que "the fungus in its entirety is without a name".

Sur le plan générique, si l'inclusion des genres Chalaropsis et Thielaviopsis, pléomorphiques, dans le genre Chalara, monomorphique, peut être interprété comme l'adoption d'un concept "botanique" du genre Chalara, typifié par une espèce imparfaite plutôt que par une forme conidienne, on ne comprend pas alors pourquoi les auteurs nomment la forme phialidique "Chalara state" et la désignent comme "lectostate" de Chalaropsis et Thielaviopsis rendant ainsi le concept de ces deux genres monomorphique pour les placer en synonymie du genre monomorphique Chalara. C'est là une procédure de traitement des genres pléomorphiques caractéristique d'un système "anatomique" de nomenclature.

Sur le plan spécifique, l'option des auteurs restent ambiguë. Puisque dans un système "botanique" de nomenclature des champignons imparfaits, les épithètes spécifiques doivent s'appliquer à toute la phase imparfaite du champignon et l'épithète correcte choisie selon sa priorité, indépendamment de la forme conidienne ou hyphale particulière qui la typifie, on s'attendait à ce que les auteurs, s'ils adoptent un système "botanique" au niveau de l'espèce, appliquent ce principe aux épithètes d'espèces pléomorphiques de *Chalara*. Malheureusement, seuls deux des quatre noms spécifiques appliqués à des espèces pléomorphiques dans *Chalara* sont corrects, *Chalara thielavioides* et *C. ovoidea*, les autres n'étant pas en accord avec un système "botanique" au niveau de l'espèce. En effet *Chalara paradoxa* est incorrect, puisque deux épithètes synchrones prioritaires, *Cylindrium intermixtum* McAlpine et *Coniosporium radicicola* McAlpine, sont disponibles, quoiqu'elles aient été typifiées par une seule forme conidienne. De même l'épithète de *Torula basicola* Berk. & Br. ne devait pas être écartée parce que typifiée par la seule forme conidienne thallique et être remplacée par une nouvelle épithète, *Chalara elegans*, basée sur un nouveau type porteur de la forme phialidique et publiée comme "espèce" nouvelle. Puisque dans ces deux cas, il est refusé aux épithètes données à des formes d'une même espèce le droit de s'appliquer à l'entièreté de l'espèce imparfaite, il faut reconnaître que les auteurs appliquent un système "anatomique" de nomenclature où l'espèce peut avoir autant de noms que de formes imparfaites. Si l'intention des auteurs est d'appliquer un système "botanique", le nom *Chalara elegans* Nag Raj & Kendrick est *nomen superfluum*.

Huit espèces d'Ascomycètes ont une phase imparfaite *Chalara*, sept *Ceratocystis*, *C. autographa*, *C. adiposa*, *C. coerulescens*, *C. fagacearum*, *C. moniliformis*, *C. paradoxa*, *C. radicicola*, et l'espèce *Cryptendoxyla hypophloia*. Cette phase imparfaite est citée comme "*Chalara* state of ..." et aucune épithète, même si elle est disponible (p. ex. *C. punctulata* considéré comme synonyme), n'est appliquée à ces phases imparfaites. Mais dans les trois cas de *Ceratocystis coerulescens*, *C. fagacearum* et *C. paradoxa*, les auteurs renvoient à des espèces imparfaites qu'ils dénomment et numérotent séparément, respectivement *Chalara ungeri*, *C. quercina* et *C. paradoxa*. Ils expriment le doute qui subsiste sur la connection de *Chalara ungeri* avec *Ceratocystis coerulescens*, mais se taisent sur les deux autres cas. Serait-ce dire que la connection entre ces autres espèces seraient aussi douteuse?

Le genre *Chalara*, tel que revu par les auteurs, comprend 70 espèces, desquelles la contribution des auteurs est 27 espèces nouvelles et 8 décrites par eux en 1974. C'est dire l'importance de la contribution des auteurs.

L'étude a essentiellement été basée sur du matériel d'herbier. Les auteurs eux-mêmes regrettent n'avoir pu étudier qu'un petit nombre d'espèces (4) en culture. Cela ne diminue pas la qualité de cette étude, la précision des descriptions et la valeur des figures.

Les auteurs récapitulent aussi la taxonomie de quelques genres voisins, *Chaetochalara*, *Sporoschisma*, *Fusichalara*, *Sporendocladia*, *Bloxamia* et *Ascoconidium*. Ils décrivent aussi deux discomycètes nouveaux, *Calycellina carolinensis* et *Hyaloscypha cladii*, étroitement associés ou connectés à *Chaetochalara aspera* et *C. cladii*.

La bienvenue sera certainement donnée à cette monographie dont les qualités sont indéniables et l'édition attrayante.

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NOTES CONCERNING A NEW DISTRIBUTION RECORD FOR GEOPORA (PEZIZALES) FROM ALASKAN TUNDRA

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It has been documented (Trappe, 1976) that certain mammals, particularly Sciuridae and Cricetidae (Rodentia), and Talpidae and Soricidae (Insectivora), are important in the dispersal of spores of certain hypogeous ascomycetes for they use these fungi as a food source. During the 1973 Alaskan summer field season, Mr. Herbert Melchoir brought in for identification a fungus collection that had been excavated by a sciurid rodent. The fungus, Geopora cooperi Harkness forma gilkeyae Burdsall (1968, p. 518), occasionally encountered by Melchoir, was found partially eaten at burrow entrances of the "Parka" or "Arctic Ground Squirrel," Citellus undulatus Poll. The retrieving of ascocarps from below ground level and opening them to the air above may be responsible for the maintaining of the forcible ascospore discharge mechanism found in this hypogeous species.

Geopora cooperi f. gilkeyae has been collected in Idaho, Colorado, California, and Alaska, usually in association with conifers (Pinus sp., Abies sp., Picea sp.) and occasionally with aspen (Populus sp.). The only reported Alaskan collection (V. Wells 310) is from a spruce stand 180 miles east of Anchorage. Our collection (OKM/GAL 11292, VPI) comes from a sand dune area at the base of Mt. Angmakrok and along the Kukpuk River. This collection site is 685 miles northwest of Anchorage, 150 miles north of the arctic circle at 68° 16'N Lat., 165° 36'W Long, and at an elevation of 150 feet. The collection represents a new Alaskan Arctic tundra record and is particularly interesting because of its association with *Salix alaxensis* (Anderss.) Cov., the feltleaf willow with which it is most likely ectomycorrhizal. *Salix alaxensis* is scrubby, reaching only 50-150 cm in height, but it is the only woody species with which the fungus could be associated.

Our collection fits the description of Burdsall (1968, p. 518), except that we found: (1) a slightly larger globose to subglobose ascospore having a size range of (17-)19-27(-30) X 17-19 μ; and (2) poorly developed ectal excipular hairs, arranged not in conspicuous tufts, but rather into a very loosely interwoven mantal up to 250 μ thick.

This range extension indicates that *G. cooperi* and its varieties may be important mycorrhizal associates over a much wider distribution and with more tree species than previously considered.

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1. Burdsall, H. H., Jr. 1968. A revision of the genus *Hydnocystis* (Tuberales) and of the hypogeous species of Geopora (Pezizales). Mycol. 60 (3): 496-525.

2. Trappe, J. M. 1976. Spore dispersal of hypogeous fungi, 27th Annual AIBS, Tulane University, New Orleans, Louisiana.

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CONTRIBUTION TO THE LICHEN FLORA OF ARGENTINA.

IX. Some Lichens from the Provinces of Santa Fe and Santiago del Estero

HECTOR S. OSORIO (1) and LIDIA I. FERRARO (2)

Among the specimens recently collected by members of the Departamento de Botánica, Facultad de Agronomía, Universidad del Nordeste, Corrientes, Argentina (CTES), we have identified some from the Provinces of Santa Fe and Santiago del Estero.

Although the number of samples is rather small, we consider it a matter of interest to make them known, inasmuch as neither province has been studied from the point of view of their lichen flora.

All of the species mentioned are corticolous and have been preserved in CTES and MVM (Departamento de Botánica, Museo Nacional de Historia Natural, Montevideo, Uruguay).

Caloplaca holocarpa (Hoffm.) Wade

SANTA FE: Depto. de San Jerónimo: Arroyo Colastiné (Highway 11, 15 km S from Coronda). *Krapovickas & Irigoyen* 27 Jan. 1971. First report for North Argentina. Previously reported from Tierra del Fuego (Cengia Sambo, 1926), Islas Malvinas (Dumont D'Urville, 1826) and Rio Negro Province (Müll. Arg., 1889).

Candelaria fibrosa (Fr.) Müll. Arg.

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SANTA FE: Depto. San Jerónimo, Arroyo Colastiné (Highway 11, 15 km S from Coronda). *Krapovickas & Irigoyen* 27 Jan. 1971.

Parmelia microsticta Müll. Arg.

SANTA FE: Depto. Gral. Obligado, Villa Ana. *Quarín* 26 Dec. 1972.
SANTIAGO DEL ESTERO: Depto. Copo, 6 km SE of Los Pirpintos. On *Aspidosperma quebracho-blanco*. *Ferraro & Schinini* 600.

Parmotrema austrosinense (Zahlbr.) Hale

SANTIAGO DEL ESTERO: Depto. Moreno, Highway 6, 40 km W of Quimilí. On *Prosopis*. *Krapovickas & Cristobal* 24 Dec. 1971. Its distribution area, known at present in Argentina, is primarily in the northeastern region: Chaco (Hale, 1965) and Corrientes (Osorio & Ferraro, 1975).

Parmotrema praesorediosum (Nyl.) Hale

SANTIAGO DEL ESTERO: Depto. Copo, 6 km SE of Los Pirpintos. On *Aspidosperma quebracho-blanco*. *Ferraro & Schinini* 598. Previously known from Tucumán (Hale, 1965).

Parmotrema reticulatum (Tayl.) Choisy

SANTIAGO DEL ESTERO: Depto. Copo, 6 km SE of Los Pirpintos. On *Aspidosperma quebracho-blanco*. *Ferraro & Schinini* 594. New to North Argentina. The northernmost previously known locality was Mendoza (Räsänen, 1941).

Parmotrema subcaperatum (Kremp.) Hale

SANTIAGO DEL ESTERO: Depto. Copo, 6 km SE of Los Pirpintos. On *Aspidosperma quebracho-blanco*. *Ferraro & Schinini* 599.

Parmotrema uruguense (Kremp.) Hale

SANTIAGO DEL ESTERO: Depto. Moreno, Highway 6, 40 km W of Quimilí. On *Prosopis*. *Krapovickas & Cristobal* 24 Dec. 1971.

Ramalina ecklonii (Spreng.) Mey. & Flot.

SANTIAGO DEL ESTERO: Depto. Moreno, Highway 6, 40 km W of Quimilí. On *Prosopis*. *Krapovickas & Cristobal* 24 Dec. 1971.

SANTA FE: Depto. Gral. Obligado, Villa Ana. *Quarín* 26 Dec. 1972.

Ramalina usnea (L.) Howe

SANTA FE: Depto. Gral. Obligado, Villa Ana. *Quarín* 26 Dec. 1972. Previously known from Corrientes (Osorio, 1970).

Teloschistes chrysophthalmus (L.) Th. Fr. var. *cinereus* Müll. Arg.

SANTA FE: Depto. San Jerónimo, Arroyo Colastiné (Highway 11, 15 km S from Coronda). *Krapovickas & Irigoyen* 27 Jan. 1971.

Teloschistes exilis (Michx.) Vain.

SANTA FE: Depto. San Jerónimo, Arroyo Colastiné (Highway 11, 15 km S from Coronda). *Krapovickas & Irigoyen* 27 Jan. 1971.

Teloschistes flavicans (Sw.) Norm. var. *acromelas* (Pers.) Müll. Arg.

SANTA FE: Depto. Gral. Obligado, Villa Ana. *Quarín* 26 Dec. 1972. Previously known from Corrientes (Osorio & Ferraro, 1975).

Usnea sulcata Mot.

SANTA FE: Depto. Gral. Obligado, Villa Ana. *Quarín* 26 Dec. 1972.

The authors thank Dr. Mason E. Hale, Jr. for help in many ways.

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MYCOTAXON

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STUDIES ON THE SPORES OF MYXOMYCETES. II. PHYSARUM STRAMINIPES[1,2]

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INTRODUCTION

Physarum straminipes A. Lister is one of the less common species of Myxomycetes which, in North America, is known only from Oregon (Hagelstein, 1944; Martin, 1949; Martin and Alexopoulos, 1969). In the original description A. Lister (1898) states: "...the spores as seen with moderate magnification, are dark purple-brown, with a mottled appearance; high magnification shows the spore-wall to be olive-brown beset with crowded dark warts occupying broad irregular patches; these are separated from each other by nearly smooth intervening spaces, having the effect of pale bands." Macbride (1922), Macbride and Martin (1934) and later Martin (1949) all say "spores....warted, the papillae in definite patches." Hagelstein (1944), in his monograph patterned after Lister's *The Mycetozoa* (1925), describes the spores as "marked with broad patches of warts separated by smoother tracts..." Finally, Martin and Alexopoulos (1969) describe the spores of *Physarum straminipes* as "...prominently warted with larger warts grouped in clusters..." The illustrations of the spores in Lister's original description (1898); in the third edition (1925) of the Lister monograph; and in Martin and Alexopoulos (1969) all show prominent, smooth, wide bands separating the groups of warts, giving the spores a reticulate appearance.

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[1] The first article of this series in Trans. Am. Microsc. Soc. 90: 473-475.

[2] Partially supported by NSF grant #DMR-7504020 to R. W. Scheetz.

In view of our results (Scheetz and Alexopoulos, 1971) with the spores of Badhamia gracilis (Macbr.) Macbride and Reticularia lycoperdon Bull. both of which exhibit ridgelike areas on their surfaces, we thought it interesting to elucidate the nature of the "bands" separating the wart groupings on the spores of P. straminipes, despite the fact that neither the original description, nor any of the later monographs describes them as ridges.

MATERIALS AND METHODS

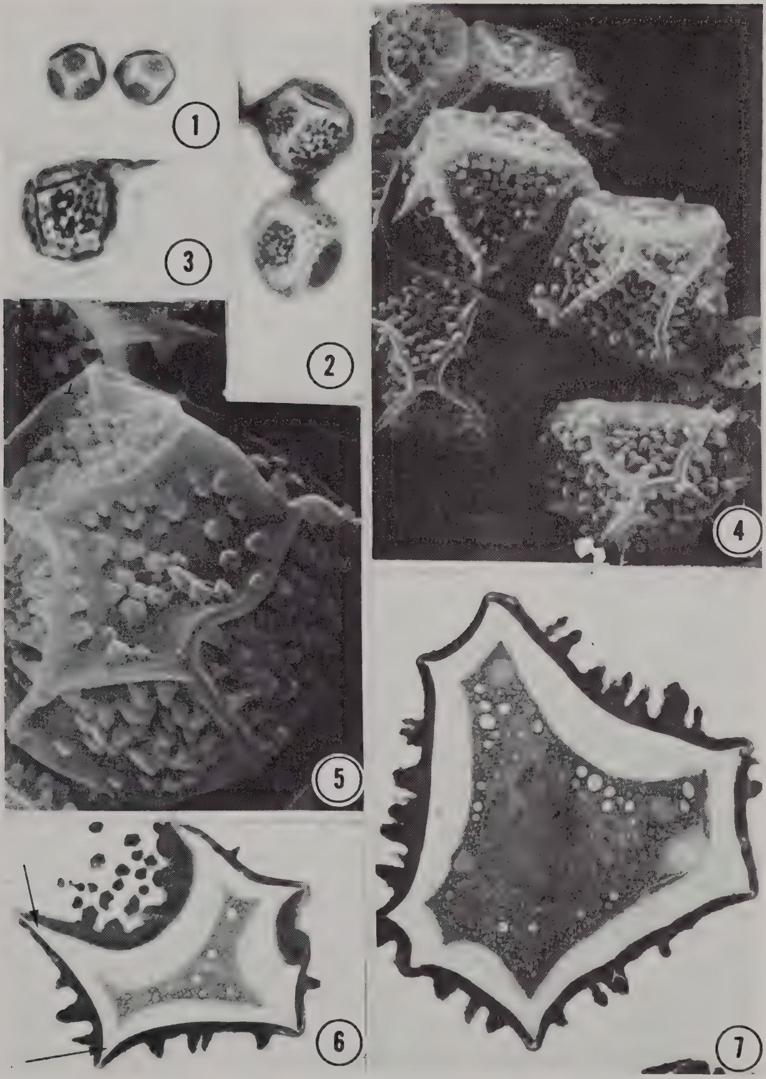
New York Botanical Garden specimen No. 10931 of P. straminipes marked type material, was borrowed through the courtesy of Dr. Clark Rogerson. Another specimen, was borrowed from the University of Iowa through the courtesy of Dr. R. L. Hulbary. Both specimens were collected in England.

For both bright field and phase contrast light microscopy, spores were mounted in Amman's medium (Martin and Alexopoulos, 1969, p. 15), on a slide, covered with a #0 square cover slip, and heated gently over a small flame for examination with the high dry (40X) and the oil immersion (100X) objectives. For scanning electron microscopy (SEM), spores were fixed in 2% glutaraldehyde, 0.1 M cacodylate, pH 7.2, dehydrated, and dried in a critical point drying apparatus. They were then coated with carbon followed by palladium (40%) and gold (60%) prior to examination in an AMR 1000A scanning electron microscope.

For transmission electron microscopy (TEM), spores were coated with 2% agar and fixed at room temperature in 2% glutaraldehyde, 0.1 M cacodylate, pH 7.2. They were then post fixed in 2% osmium tetroxide in the same buffer and then bulk stained with 0.5% uranyl acetate. Following dehydration, spores were embedded in a hard formulation of Spurr's low viscosity plastic. Sections were cut with a diamond knife using a Porter Blum MT 2-B ultramicrotome. Thin sections were stained with uranyl acetate followed by lead citrate and viewed in a Siemens Elmiscope 1A electron microscope.

RESULTS AND DISCUSSION

Examination of the spores of P. straminipes with a bright field, high dry (40X) objective shows (Fig. 1) the wide smooth bands between the groups of warts as described by all previous investigators. The 100X oil immersion objective, however, both with bright field and phase contrast optics shows them to be reticulately ridged (Figs. 2, 3). SEM micrographs (Figs. 4, 5) confirm the presence of ridges between the warted areas of the spores and show them to be virtually devoid of warts. As in Badhamia gracilis, however, these ridges do not appear to be homologous with what might be called true ridges like those of Reticularia lycoperdon spores, but rather pointed



Figs. 1-7. Spores of Physarum straminipes A. Lister N.Y.B.G. #10931 (Type material). Figs. 1-2. Bright field. Fig. 1. 40X objective, X1000. Fig. 2, oil immersion, X1500. Fig. 3. Phase contrast, oil immersion, X1500. Figs. 4-5. SEM X3500 and 8700 respectively. Figs. 6-7. TEM X6400 and 8000 respectively. (Magnifications approximate).

extensions of the entire spore wall which are duplicated inside the spore by the protoplast itself (Figs. 6, 7). True ridges are ornamentations which are an integral part of the outer, electron dense wall layer (See Scheetz and Alexopoulos, 1971). The study of both specimens cited above, yielded identical results.

Thus, we have another myxomycete spore which appears to be reticulately ridged but in which the ridges are not formed in the same way as warts or spines, but rather represent a permanent wrinkling of the spore itself. This is not due to loss of turgidity but is an inherent character of the mature spore as shown by the presence of the ridges on spores mounted in Amman's medium and expanded by heating, as well as in critically dried specimens. The spores of P. straminipes then should be described as "bearing clusters of prominent warts separated by nearly smooth ridges."

The results described above once more illustrate the value of the SEM in examining the surface markings of myxomycete spores. Direct observations with the high power, bright field objective of the light microscope sometimes fail to reveal the true nature of spore markings (Fig. 1). Even phase contrast optics are sometimes inadequate, but are admittedly much better than bright field (Fig. 3), as shown by the failure of careful observers (Lister, 1898; Hagelstein, 1944; Martin, 1949) to detect the ridges on the spores of P. straminipes, so clearly illustrated by SEM.

We do not know whether good quality oil immersion objectives were available to Arthur Lister and Hagelstein. We do know that Martin did use an apochromatic oil immersion lens for observing surface markings and for drawing them, as reported on the page just preceding the illustrations in Macbride and Martin (1934). Unfortunately, P. straminipes is not among the species illustrated in that monograph. We are at a loss, consequently to understand how a careful observer like Martin failed to see the ridges on these spores.

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CALLORIOPSIS AND MICROPYXIS: TWO DISCOMYCETE GENERA IN THE CALLORIOPSIDEAE TRIB. NOV.

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A study of two monotypic genera of Discomycetes, *Calloriopsis* Sydow and *Micropyxis* Seeler, has led me to conclude that the two genera are closely related and deserve to be placed together in a new tribe of the Leotiaceae. The Discomycetes referred to these genera are parasitic on other fungi, have gelatinous, relatively simply constructed sessile apothecia, and have small iodine negative, inoperculate asci. Coincidentally, both species either have been described as members of the Hypocreales or have been confused with Hypocrealean fungi.

Calloriopsis Sydow

The genus *Calloriopsis* is based upon a parasitic inoperculate discomycete which occurs on *Meliola* and related black mildews. First collected and described from Florida as *Peziza gelatinosa* Ellis and Martin, it is known throughout the tropical regions.

There has been a great deal of nomenclatural and taxonomic confusion over this fungus. The name *Peziza gelatinosa* Ellis and Martin is a later homonym of *P. gelatinosa* Bull. ex Merât. According to Article 72 of the *International Code of Botanical Nomenclature* the Ellis and Martin name has no status. Saccardo (1899) first combined this epithet under another genus, *Orbilia*. In so doing he became the publishing author. The first valid name for this species is *Orbilia gelatinosa* Sacc. By reason of its parasitism of *Meliola* it has often been confused with

Peziza leucorrhodina Mont. which is properly placed in the genus *Nectria* (Samuels 1976). Although this had been stated earlier by von Hohnel (1909) and others, Seaver (1951) nonetheless used the name *Trichobelonium leucorrhodinum* for this discomycete. Earlier the Montagne name had been used by Spegazzini (1888) under *Scutula* for this fungus. *Belonidium leucorrhodinum* (Mont.) Sacc. was used by Seymour (1929) and Seaver (1925).

I have examined several collections of *Calloriopsis gelatinosa*, including the type. The description below is based upon these collections. I consider *Calloria meliolicola* P. Hennings a synonym.

Calloriopsis gelatinosa (Sacc.) Sydow, Ann. Mycol. 15: 254. 1917. FIG. 1
≡[*Peziza gelatinosa* Ell. & Mart., Amer. Nat. 17: 1283. 1883, later homonym, non *Peziza gelatinosa* Bull. ex Merât, nec *Peziza gelatinosa* Haller].
≡*Orbilia gelatinosa* Sacc., Syll. Fung. 8: 624. 1889, (attributed to Ellis & Martin) first valid publication of epithet, Art. 72.
≡*Coryne gelatinosa* (Sacc.) Rehm, Ann. Mycol. 5: 518. 1907.
=*Calloria meliolicola* P. Henn., Botanisch. Jahrb. 25: 509. 1898.
≡*Coryne meliolicola* (P. Henn.) v. Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1. 118: 106. 1909.

Ascocarps 0.4-0.6 mm in diam, with a free margin, when dried translucent yellowish to orange to pinkish, sometimes situated upon an inconspicuous subiculum. The gelatinous material in the sterile tissue is found throughout the subhymenium, ectal excipulum and medullary excipulum. The subhymenium is composed of small tightly interwoven hyphae. The cortical layer is composed of parallel hyphae which are imbedded in gel. Lactophenol cotton-blue stains only the cytoplasm, in what appear to be thin lumenal cavities. When mounted in congo red in ammonia, the gel appears to dissolve and the cortical layer, composed of septate, thin-walled hyphae which are swollen at the tip, can be seen. The medullary zone is composed of interwoven hyphae with occasional swollen cells. These swollen cells may represent

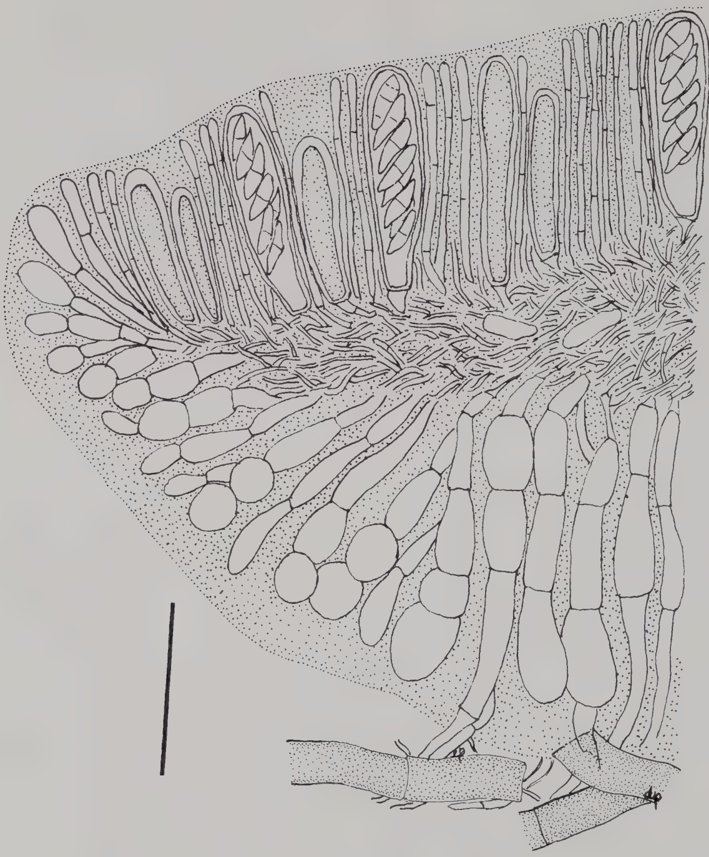

FIG. 1. Median section through an apothecium of *Calloriopsis gelatinosa* situated on mycelium of a *Meliola*. The scale is equivalent to 25 µm. (Drawn from the J. R. Bartholomew collection in FH from Florida cited in the text.)

remnants of the ascogonial system. Asci are short clavate, thick-walled (particularly in young asci), 8-spored, 40-52 x 11-15 μm. Paraphyses are filamentous, unbranched 1.5-2.5 μm in diam, sometimes swollen at the tip to 3.5 μm. The paraphyses sometimes arch over the asci but do not form a true epithecium. The hymenium is filled with gel which extends well above the hymenium. The ascopores are ellipsoid to almost fusoid, sometimes curved, one or two septate, (10-)12-16 x 3-6 μm. The asci and apothecial tissues are J-. The subiculum, when present, is composed of interwoven hyphae which are sometimes swollen to produce occasional moniliform hyphae.

Occurring in groups on the mycelium of *Meliola* spp. and related foliicolous ascomycetes.

Specimens examined - Java: auf *Phragmites* sp. an *Meliola substenospora* v. H., Buitenzorg, von Höhnel, 1907-08, FH. This collection was also issued in Rehm, Ascomyceten as number 1851 and was identified as *Calloria meliolicola*. Puerto Rico: [on *Meliola*] on leaves of herbs, Mayaguez, Fink number 938, Dec. 17, 1915, FH. Guadeloupe: sur les feuilles, citromier vivant, Camp Jacob, Duss 766, Mai 1903, Patouillard Herbarium, FH. U.S.A.: Florida, on *Meliolina*?, on black gum (*Nyssa*), Winter Park, 1939, Jas. R. Bartholomew, FH; Holotype: on living leaves of *Persea palustris*, on patches of sterile mycelium of some *Meliola*, Ellis coll., NY.

Micropyxis Seeler

Seeler (1943) very precisely described the only species placed in *Micropyxis*, *M. geoglossi* (Ell. & Ev.) Seeler. Seeler's description of it is quoted below. He considered it as a very reduced member of the Helotiaceae, with which opinion I agree. I have reexamined his material on deposit at the Farlow Herbarium. *Micropyxis* has been treated by Korf (1973) in the tribe Mniaecieae. Save for their small sessile apothecia, few traits are shared by *Micropyxis* and the other, primarily bryophilous, members of the Mniaecieae.

Micropyxis geoglossi (Ell. & Ev.) Seeler, Farlowia 1: 126. 1943.
≡*Hypomyces geoglossi* Ell. & Ev., J. Mycol. 23: 73. 1972.

≡*Peckiella geoglossi* (Ell. & Ev.) Sacc., Syll. Fung. 9: 944. 1891.
≡*Eleutheromyces geoglossi* (Ell. & Ev.) Seaver Mycologia 1: 48. 1909.

"Ascocarps superficial, parasitic on hymenial surface of members of the Geoglossaceae, growing close together, mostly distinct, rarely anastomosing, pale yellow-brown, translucent and gelatinous when wet, shrunken and brittle when dry, resembling microscopic droplets of dark resin, at first spherical, finally up to three times as broad as high, 60-150 μ diam x 60-70 μ high, ascus layer 25-45 μ deep; base (hypothecium) short, of thick-walled gelatinous hyphae, pseudoparenchymatous, lower part composed of hyphae which spread out, surrounding the tops of host paraphyses and asci and wedging between them and connecting to the bases of neighboring apothecia; excipulum formed of a single layer of branching filaments in an amber-colored gelatinous substance; these arch over the tops of the asci in young apothecia almost completely covering them; no true epithecium of fused tips of paraphyses; pale amber gelatinous material covers the tops of the asci. Asci eight-spored, clavate, short-stiped, stipes mostly broad, thickened, obtuse apex, 28-45 x 6.4-8.3 μ rarely a little longer. Paraphyses hyaline, filamentous, simple or once-branched near base, 1.2-1.6 μ diam, tips never branched, swollen, 1.9-3.2 μ diam, slightly overtopping the asci and about as numerous as they. Spores one-celled, hyaline, long elliptical or tapering toward base, ends rounded, irregularly distichous, 7.7-10.5 x 2.5-3.2 μ. No parts blue with iodine.

Besides the collections on *Trichoglossum farlowii*, *T. Walteri*, and *Geoglossum* spp. mentioned by Seeler from Massachusetts, New Jersey, Tennessee, and North Carolina, I have also seen a collection from Jamaica (CUP-MJ-311) on *Trichoglossum rasum* gathered and determined by Dr. R. P. Korf. No doubt the fungus is widely distributed through temperate and tropical regions. Its diminutive stature and near disappearance upon drying make it a particularly difficult fungus to discern.

DISCUSSION

The Tribe Calloriopsideae

Calloriopsideae trib. nov., family Leotiaceae, subfamily Leotioideae.

Apothecia parva vel minuta, sessilia, composita hypharum comparate simplicium. Hyphae in gelatina inclusae. Ascosporae hyalinae, 1-3 septatae, asci J-. Parasitici in fungis. Typus: Calloriopsis *Syd.*

The two genera included, *Calloriopsis* and *Micropyxis*, should pose no problems for identifications. The obvious differences in host preferences aside, the amber gel, simpler apothecial construction, one-celled ascospores and smaller asci of *Micropyxis* easily distinguish it from *Calloriopsis*.

Calloriopsis gelatinosa has certain similarities to some of the species now placed in the genus *Scutula* Tul. of the Patellariaceae. These lichen parasites, as a group, agree in apothecial construction with *C. gelatinosa*. Species placed in *Scutula* should be examined in light of their possible alliance with *C. gelatinosa*.

The presence of gelatinous material in the apothecia of these fungi and their parasitic habit are major features which distinguish them from most other members of the Leotioideae. Possession of gel is not unique to these fungi, but the dependence upon gel for apothecial integrity is of importance. Gel is found in the apothecia of both *Calloriopsis gelatinosa* and *Micropyxis geoglossi* in all zones, including the hymenium. Such abundance of gel has probably served a twofold function. On the one hand it may serve as a water storage material and on the other hand, it must serve as a protective barrier against excessive water loss. By virtue of the position of these fungi on their substrates they are exposed in their entirety, including their superficial mycelium, to the desiccating effects of wind and excessive light and heat. The gel which surrounds all of the thin-walled hyphal elements of the apothecium undoubtedly retards the inevitable evaporation.

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MYCOTAXON

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TAXONOMY OF MALBRANCHEA AND SOME OTHER HYPHOMYCETES WITH ARTHROCONIDIA

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ABSTRACT

The relationship of Malbranchea to other Hyphomycete form-genera is discussed and a tabular key to morphologically related genera is provided.

In Part I, generic names which are linked in some way to Malbranchea are treated in alphabetical order. They are Arcuadendron (new genus), Arthrographis (newly validated), Bahusakala, arthroconidial states of Basidiomycotina (without form-generic names), Briosia, Chrysosporium, Coccidioides, Coremiella, Geomyces (lectotype chosen, 1 new species, 1 new combination), Geotrichum, Mauginiella, Oidiodendron, Oidium, Oospora (rejected), Ovadendron (new, for Oospora sulphureo-ochracea), Ptychogaster, Scytalidium (key to species, 1 new combination) and Sporendonema. In the treatment of Oidiodendron, Myxotrichum striatosporum is proposed as a new combination for Arachniotus striatosporus and M. setosum is described as having an Oidiodendron conidial state.

In Part II, the species of Malbranchea are described and illustrated. The type species, M. pulchella Saccardo & Penzig, is redefined and M. pulchella var sulfurea (Miehe) Cooney & Emerson is raised to specific rank. Eleven new species are described and illustrated: M. albolutea, M. arcuata, M. aurantiaca, M. chrysosporoidea, M. circinata, M. dendritica, M. flava, M. flavorosea, M. flocciformis, M. fulva and M. gypsea. A new heterothallic genus of the Gymnoascaceae (Ascomycotina) is proposed for a single species, Uncinocarpus reesii, having a Malbranchea conidial state. The perfect states of some species of Malbranchea belong in the genera Auxarthron and Myxotrichum of the Gymnoascaceae.

INTRODUCTION

In our studies of keratinolytic and other soil fungi, we accumulated many cultures forming arthroconidia. These were at first filed in our collection under Geotrichum sp. or Malbranchea sp. This paper is a result of our attempts to identify or classify these strains.

It has long been known that a variety of fungi can form spores by fragmentation of their hyphae into segments. Now often called arthroconidia, these segments were formerly called oidia or arthrospores. The fungi which produced them were usually assigned to the form-genera Oidium or Oospora, both of which became dumping grounds for a wide variety of arthroconidial and other fungi. The relatively undifferentiated structure of the hyphae which produce arthroconidia, and the simple cylindrical form of the conidia have hindered attempts to sort them out.

In 1953, Hughes drew attention to the ontogeny of meristem arthroconidia, which are formed in basipetal succession on a continuously elongating conidiogenous cell. This allowed a clear separation of the conidial states of the Erysiphaceae from the rest of the 'Oidiums', and the genus name Oidium has now been conserved for this group (see Taxon 24:534, 1975). The fungi with slimy, fission arthroconidia (arthroconidia which separate from each other by fission of their common septum) were clearly established in Trichosporon by Lodder and Kreger van Rij (1952) and in Geotrichum by Carmichael (1957). In 1957, Pesante created Scytalidium for dematiaceous fungi with fission arthroconidia. However, fungi with hyaline, dry, fission arthroconidia are still not well provided with form-genera. We will validate Arthrographis for one group of them (vide infra), but the arthroconidial states of Basidiomycotina need further work.

The fungi with alternate arthoconidia (arthroconidia which are spaced apart from each other by separating cells) are also not well sorted into form-genera. Barron (1962) redescribed Oidiodendron in modern terms, but Sporendonema and Coremiella are poorly known to most mycologists. We will describe and illustrate some of their species. Saccardo created Malbranchea in 1882 for fungi with alternate arthroconidia formed on curved branches, but the genus was seldom mentioned until Cooney and Emerson described a thermophilic variety in 1964. We found that most of our previously undescribed species could be accommodated in Malbranchea by slightly revising its circumscription to include fungi with small, alternate arthroconidia borne on either straight or curved branches. For similar-appearing fungi whose conidiogenous hyphae continue to grow after the initiation of each conidium, we describe the new genus Arcuadendron. For a species similar to Malbranchea, but having swollen arthroconidia, we describe the new genus Ovadendron.

Part I of this paper starts with a key to the genera, followed by a treatment (in alphabetical order), of the generic names which are linked to arthroconidial fungi. New species and some classical species are described and illustrated for many of the genera. Part II is a treatment of Malbranchea, with descriptions and illustrations of all the species. We include in the form-genus Malbranchea both cellulolytic and keratinolytic species. These are probably not closely related phylogenetically. Indeed, some cellulolytic species are known to have Myxotrichum perfect states, whereas some keratinolytic species have Auxarthron perfect states. For one species, we describe the new Gymnoascaceous genus Uncinocarpus.

MATERIALS AND METHODS

SPECIMENS AND CULTURES: At the beginning of this study, the University of Alberta Mold Herbarium and Culture Collection contained approximately 100 strains of Malbranchea that had been collected over a period of 10-12 years. Many of these were originally isolated by Dr. G. F. Orr (Deseret Test Center, Dugway, Utah) during his studies on Gymnoascaceae. Additional cultures were obtained from Dr. Z. Hubalek (Institute for Parasitology, Prague) who sent some isolates collected during his studies of birds (Hubalek, Balat, Touskova and Vik, 1973; Hubalek and Balat, 1974; Hubalek, 1974a,1974b), and from Dr. K. Tubaki (Institute for Fermentation, Osaka)(IFO) who exchanged a number of cultures. Mrs. C. A. Johansen (Western Forest Products Laboratory Culture Collection of Wood Inhabiting Fungi, Vancouver)(WFPL) kindly sent several cultures of Ptychogaster. Further reference cultures were obtained from the Centraalbureau voor Schimmelcultures (CBS), Baarn; the Commonwealth Mycological Institute (CMI), Kew; and the Department of Agriculture (DAOM), Ottawa. Herbarium specimens were received from the New York Botanical Garden Cryptogamic Herbarium (NYBG), and the Herbarium of the Commonwealth Mycological Institute (IMI), Kew.

Abbreviations for other culture collections or herbaria cited in the text are:

ATCC	-American Type Culture Collection, Rockville, Maryland
CDC	-Center for Disease Control, Atlanta, Georgia
NRRL	-Northern Utilization Research Development Division, Peoria, Illinois
RSABG	-Rancho Santa Ana Botanic Garden, Claremont, California
UAMH	-University of Alberta Mold Herbarium and Culture Collection, Edmonton, Alberta

Dried colonies of the type strain of each new species are maintained in the UAMH as holotype. Subcultures of the type strain are deposited in the CMI, CBS and ATCC.

CULTURE METHODS: Media used in the study consisted of phytone yeast extract agar (PYE) (Carmichael, 1962), pablum mixed cereal agar (Carmichael, 1962), dextrose-salts agar (DSA) (Carmichael, 1962), and oatmeal-salts agar (medium E) (Weitzman and Silva-Hutner, 1967; Padhye, Sekhon and Carmichael, 1973). PYE is available in dehydrated form from Baltimore Biological Laboratories, Cockeysville, Md. Pablum mixed cereal is marketed as baby food by Mead Johnson Nutritionals, Evansville, Ill.

Cellophane plates were prepared by laying a single sterile (62 x 62 mm) cellophane membrane designated 300 PT (plain, transparent) over the surface of an agar plate prepared in a 90 mm plastic disposable petri dish (Carmichael, 1962). The cellulolytic ability of the fungus was determined by its capacity to digest this membrane either partially or completely.

Cellophane plates were inoculated from the periphery of two week old colonies on cereal slants which were then maintained at 8 C as stock cultures. Each strain was inoculated in triplicate to PYE, cereal and oatmeal agar plates. The effects of temperature were recorded by incubation of a single PYE and cereal plate at each temperature of 25 C, 37 C and 45 C for a maximum of 21 days. A single oatmeal agar plate was incubated at 18 C, 25 C and 30 C for 35 days. Cultures at 25 C were exposed to fluorescent room light on an irregular basis, usually 8-10 hours per day, 5 days per week. Cultures at other temperatures were incubated in darkness with exposure to light only during examination.

Each colony on PYE and cereal was examined weekly to measure the diameter and record colony characters and presence of a diffusible pigment. The diameter recorded was the average of two measurements taken at right angles to each other. Cultures on PYE and cereal were incubated for 21 days before being photographed and dried. Colonies were dried by removing the cellophane membrane to a press (Carmichael, 1963). Colonies on oatmeal agar were examined at 35 days. If cleistothecial initials appeared or cleistothecia were not mature, oatmeal plates were kept 2-4 weeks longer.

The keratinolytic activity of a fungus *in vitro* was determined by the amount of digestion of the hair when the fungus was grown on a nutritionally minimal medium (DSA) sprinkled with hair (Carmichael, 1962). After two weeks growth, hairs were examined microscopically to record the extent of visible digestion and the degree of penetration of the hyphae with or without the aid of penetrating bodies.

TECHNIQUES FOR SEXUAL CROSSES: Procedures for mating heterothallic species of the Gymnoascaceae, especially of the genera Arthroderma and Nannizzia, are well established (Dawson and Gentles, 1961; Padhye, 1969; Padhye and Carmichael, 1969, 1971, 1972, 1973). Early reports indicated that soil sprinkled with a keratin source such as feathers, hair, nail, hoof, etc. was superior to an agar medium (Dawson and Gentles, 1961; Dawson, Gentles and Brown, 1964; Stockdale, 1963). However, more recent studies (Weitzman, Kozma, and Silva-Hutner, 1969; Padhye et. al., 1973) indicate that a non-keratinous agar such as the oatmeal-salts agar (medium E) of Weitzman and Silva-Hutner (1967) stimulates excellent production of ascocarps.

Conidial suspensions were prepared by transferring a small inoculum from the periphery of a 14 day old culture grown at 25 C on cereal agar to 1 ml of sterile distilled water in a test tube. Two methods of inoculation to oatmeal-salts agar were used: A) mixed conidial suspensions, and B) parallel inoculation of separate conidial suspensions. If the organism was known to utilize keratin some sterile hairs from an adult blonde woman were sprinkled over the agar. Crosses were observed weekly to six weeks when gymnothecia were reported. Plates were retained up to 56 days before being discarded as negative.

Single ascospore isolations were made from gymnothecial strains with the aid of a de Fonbrune micromanipulator. After 24-48 hours incubation at 25 C, single germinating ascospores were transferred to PYE or oatmeal plates.

TERMINOLOGY FOR CONIDIA AND CONIDIOPHORES: The terms used in this report are primarily those recommended by the proceedings of the Kananaskis Conference on Fungi Imperfecti (Kendrick, 1971). However, aleurioconidium is retained here, in Vuillemin's (1911) original sense, for a conidium borne laterally or terminally on an undifferentiated hypha or on short pedicels and released by lysis of the supporting cell. Although aleurioconidium was rejected as a confused term, no other was proposed to replace it. The term specifies a particular method of conidium dehiscence (see Carmichael in Kendrick, 1971, p. 245).

Aleurioconidia are similar to alternate arthroconidia and often intergrade. We prefer the term 'alternate arthroconidia' over the older 'endoarthroconidia' for arthroconidia separated by one or more relatively empty segments, and released by lysis of the outer wall of the intervening segment. Another suitable term is arthroaleurie defined by Orr (1963b).

The term conidiophore is used here for a differentiated hyphal structure which supports the conidia or conidiogenous cells away from the vegetative mycelium (see Carmichael, in Kendrick, 1971, p. 47). The definition accepted by the Conference (see Kendrick, 1971, p. 227) was "a conidiophore is a system of conidiogenous cells, or a single conidiogenous cell, with or without differentiated supporting structures." A conidiophore without a differentiated supporting structure is called micronematous by Ellis (1971). A micronematous conidiophore cannot be distinguished from the vegetative hypha before the process of conidium formation begins. According to the definition used in this report, fungi developing conidia on undifferentiated hyphae lack conidiophores.

TAXONOMIC NAMES AND CROSS-REFERENCE NAMES: The genera of the Hyphomycetes are form-genera, based on the asexual reproductive part of the life-cycle of fungi. Many form-genera contain species that are known to have perfect states in the Basidiomycotina or Ascomycotina. Unfortunately, the conidial form-genera do not correlate exactly with the classification of the perfect states, since morphologically similar conidial states may have distantly related perfect states, and vice versa.

When the perfect state of a fungus is known, the Linnaean binomial (binary combination of genus name and specific epithet) applied to it is the taxonomic name for the species. Since the main advantage of taxonomic names is that they provide unique and exclusive indexing terms for species, it seems undesirable to create or maintain additional binomials for conidial states of species. In order to refer to conidial states for purposes of identification or indexing, it is more appropriate to have a system of cross-reference names that indicate the connection between the conidial form-genus and the Linnaean name for the species (see Carmichael, 1962; Hennebert, 1971; Kendrick and Carmichael, 1973; Weresub, Malloch and Pirozynski, 1974; Nag Raj and Kendrick, 1976). The conidial state may be cross-referenced by referring to it as the (form-genus name) state of (Linnaean binomial). The use of cross-reference names does not contravene any of the provisions of the International Code of Botanical Nomenclature, but does provide an additional system of names. For uniform international indexing of cross-reference names, it would be better to use the Latin abbreviation for the connection, i.e., (form-genus name) stat. (Linnaean binomial). The reverse order, (Linnaean binomial) stat. (form-genus name), is appropriate to indicate the conidial state, but index it under the species name. Previously published Linnaean binomials for conidial states can be reduced to synonymy under the appropriate cross-reference name when the perfect state connection has been established.

When the perfect state is not known, and a fungus is polymorphic, having conidial states belonging to more than one form-genus, then a Linnaean binomial can be proposed for the most prominent or most frequently encountered state (see Hughes, 1953, p. 650, 651; Carmichael, 1962, p. 1138; Hennebert, 1971, p. 215). The other conidial states can be referred to by cross-reference names. In this way, the creation of form-genera based on more than one type of conidium can be avoided. When a polymorphic imperfect fungus has already received one or more Linnaean names, then the oldest valid one would be given priority, and the later ones reduced to synonymy under the appropriate cross-reference names.

Following Hughes (1959), 1801 is taken as the starting point date for nomenclature of Hyphomycetes. This action contravenes Article 13f of the current Code. In this paper, two pre-1821 names are accepted by us for current use and attributed to their original author. These names are _Geotrichum_ Link 1809, and _Chrysosporium merdarium_ (Link 1818) Carmichael 1962.

PART I THE GENERA

KEY TO THE GENERA .... Table I

Arcuadendron Sigler & Carmichael gen. nov.

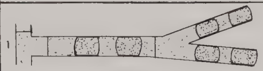
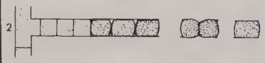
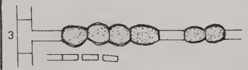
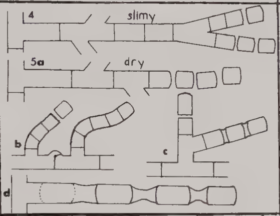
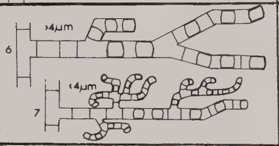
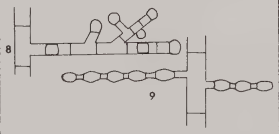
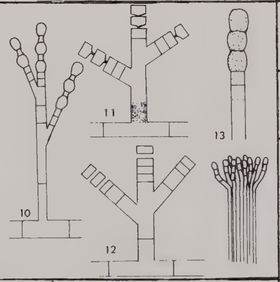
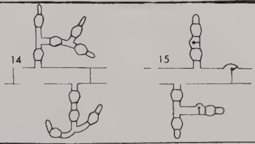
Diagnosis
Deuteromycotina, Hyphomycetes.
Hyphae hyalinae vel clarae, septatae. Conidiophorae absunt. Cellulae conidiogenae hyalinae, initio laterales, dein ex apicibus conidiorum apicalium in ordinem excrescunt, frequenter arcuatae, aliquando ramosae, demum deliquescunt. Conidia hyalina vel flava, 0-septata, in catenulatis brevibus, per cellulas vacuas disjuncta. Per deliquescere cellularum vacuarum dehiscunt.
Typus: _Arcuadendron ovatum_ Sigler & Carmichael sp. nov.

Vegetative hyphae hyaline or yellowish green, septate; differentiated conidiophores lacking. Conidiogenous cells are integrated, serial, indeterminate, progressive, growing from the apical conidium. Conidia formed in acropetal succession, are serial, alternate, separated by short, branched or unbranched hyphal segments which dissolve to release the conidia. Conidia broadly ellipsoidal or triangular with truncate ends, hyaline or yellowish, smooth or verrucose.

TABLE I KEY TO THE

Elongation of Conidiogenous Hyphae	Septation of Conidiogenous Hyphae	Maturation of Conidia	Separation Between Mature Conidia	Width of Conidium Compared to Fertile Hypha	Color of Conidia
Determinate—Hyphal Elongation Ceases After First Conidium Initial Is Differentiated	Random or Simultaneous	Random or Simultaneous	Separating Cell	Same Width	Dark
			None		
				Broader	
				Same Width	Light
			Connective		
			Separating Cell		
				Broader	
	Random	Retrogressive—From Apex to Base (Basipetal)			
			Connective	Same Width	
			None		
	Retrogressive—From Apex to Base			Broader	Dark
Indeterminate—Elongation Continues	Progressive—Behind Growing Apex (Acropetal)	Simultaneous	Separating Cell		Light

FORM - GENERA

Erect Conidiophores	Form-Genera	Figure	Sexual States
Coremia ▼	1 Coremiella		
Absent	2 Bahusakala		2 Aulographina
	3 Scytalidium		
	4 Geotrichum		4 Endomyces
	▽ 5a ?Mauginiella b ?Mauginiella c Not named d Not named		5▽ a ?Hymenomycetes b Phlebia c ?Hymenomycetes d Collybia
	6 Sporendonema		
	7 Malbranchea		7 Various Gymnoascaceae
	8 Chrysosporium		8 Various Gymnoascaceae
	9 Ovadendron		
Unpigmented	10 Geomyces		10 Pseudogymnoascus
Mostly Pigmented	11 Oidiodendron		11 Myxotrichum
Unpigmented	12 Arthrographis		
Coremia ▼	13 Briosia		
Absent	14 Arcuadendron		
Sporodochia ▼	15 Ptychogaster		15 Tyromyces

▼On natural substrate but not usually found in culture
▽Described after Bahusakala in alphabetical treatment of genera

Discussion

Arcuadendron differs from *Malbranchea* in that the fertile hypha continues to grow while forming conidia endogenously. In *Malbranchea* the hypha ceases growth before conversion to alternate arthroconidia occurs. In both, however, conidium dehiscence occurs by dissolution of the intervening segments.

Arcuadendron ovatum Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25 C velutinae, violascens, extensae. Cellulae conidiogenae in modo generis. Conidia ovoidea, truncata, flavo-viridia, verrucosa, 3-4.5 x 4-7(9)um. Typus: UAMH 2737, ex solo, India, H.C. Gugnani, S252

Colonies on PYE (Figs. 1A,1B) at 25-30 C (optimum range) are 37-39 mm in diam. in 21 days, drab violet with white or pinkish-violet center, reverse dark purple. The surface is suede-like, flat with raised center and sharp outward radiating folds developing cracks near the center (Fig. 1A); or floccose, flat near the periphery, but rising to a central plateau, smooth (Fig. 1B). Growth at 37 C is similar, 25-36 mm diam. in 21 days, drab violet, dark violet reverse, downy with few folds at the center or entirely cerebriform (Figs. 1C,1D). Colonies (Figs. 1E,1F) on cereal (diam. as on PYE) are violet, reverse dark violet, aerial growth pale buff, floccose, slightly raised with flat central plateau and glabrous margin (Fig. 1E), or yellow, powdery and flat, sectoring near the margin (Fig. 1F). The violet surface pigment does not diffuse into the agar. Colonies at 37 C grow somewhat slower (18-32 mm at 21 days) and show less luxuriant aerial growth.

Vegetative hyphae are hyaline or greenish-yellow, septate. The fertile hypha is curved (Figs. 1G-1I), narrow, 1.0-1.5um wide, arising as a lateral branch from the broader vegetative hypha; conidiogenous cells are undifferentiated. Conidia are alternate and develop serially in acropetal succession on the fertile hypha (Fig. 1G). The hypha continues to grow from the apical part of the conidium (Fig. 1J), often branching, and the conidium is delimited by an apical septum. Mature conidia (Fig. 1K), released by dissolution of the intervening hyphal segments are truncate, broadly ellipsoidal, verrucose at maturity, hyaline at first, later greenish-yellow, 3-4.5 x 4-7(9)um. The development of conidia in *A. ovatum* appears to be thallic, *i.e.*, enlargement of the conidium initial occurs after delimitation by a septum. However, septum formation is not always discernible before enlargement occurs.

No other spore state was observed and an attempt to cross the isolates was unsuccessful. *A. ovatum* is cellulolytic but not keratinolytic.

Material Examined
UAMH 2737, soil, India, from Gugnani, National Institute of Communicable Diseases, New Delhi as S252; UAMH 2746, from ulcer in a monkey, India, from Gugnani as M5259.

Arcuadendron triangularis Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25 C cremeae, densae, durae, pulveraceae, lente crescunt.
Cellulae conidiogenae in modo generis. Conidia triangularia, equilateralia, hyalina, laevia, in altitudine, 6-7um.
Typus: UAMH 3433, ex pilis, *Clethrionomys glareolus*, Yugoslavia, 1970, Hubalek BH 68 (Orr-3351)

The colony (Fig. 1L) on PYE is 20 mm diam. in 21 days, creamy white, reverse light brown. The surface is raised and convoluted, dense, tough, powdery with tiny cracks, and pale yellow exudate droplets. On cereal (Fig. 1M) the colony is flatter, 25 mm diam. in 21 days, with deep folds running parallel across the diameter of the colony, white, reverse buff, powdery. Optimum temperature 25 C; no growth at 37 C. *A. triangularis* digests cellophane but not keratin.

The vegetative hyphae are hyaline, septate, broad, 2.5-4um wide, often forming prominent racquet hyphae. Conidia are thallic, developing serially within an undifferentiated hypha; each conidium initial at first cylindrical, then expanding on one side to become triangular (Fig. 1N). Meristematic growth continues until the conidium is delimited by a septum (Fig. 1,O). The curved fertile hypha grows from the apex of the triangular conidium, forming conidia at regular intervals (Fig. 1,O). Conidia (Fig. 1P), released by disintegration of the intervening hyphal segments, are hyaline, smooth, triangular, more or less equilateral in shape, measuring 6-7um along the perpendicular from the apex to the base.

Arthrographis Cochet 1939 ex Sigler & Carmichael gen. nov.

Diagnosis
Deuteromycotina, Hyphomycetes.
Hyphae hyalinae, septatae, angustae, 1-3um. Conidiophora hyalina, arboroidea, brevia. Hyphae fertiles ramosae, per fissiones in septis ad arthrosporas disarticulant.
Conidia hyalina vel clara, cylindrica, laevia, sicca. *Geotrichi* simile, sed conidia non mucosa et conidiophora adsunt. *Oidiodendronis* simile sed disjunctores absunt.
Typus: *Arthrographis kalrai* (Tewari & Macpherson) Sigler & Carmichael comb. nov.

Vegetative hyphae septate, branched, hyaline. Conidiophores simple, hyaline, branched at the apex, appearing arborescent. Fission arthroconidia formed by disjunction and segmentation of hyaline fertile branches borne at the apex of the conidiophore, or by fragmentation of undifferentiated hyphae. Arthroconidia hyaline or yellow, smooth, cylindrical, appearing discoid in end view.

Discussion

The genus *Arthrographis* was proposed by Cochet (1939) for a single species, *A. langeroni*. Although adequately described and illustrated, it was not validly published since Cochet did not include a Latin diagnosis. *Arthrographis* resembles both *Geotrichum* and *Oidiodendron*. It differs from *Geotrichum* in forming dry fission arthroconidia on conidiophores. The conidiophores of *Arthrographis* lack the characteristic pigmentation of *Oidiodendron*. Furthermore, the arthroconidia of *Arthrographis* are smooth-walled and lack the connectives between maturing conidia that are prominent in *Oidiodendron* (Barron, 1961, 1962; Cole and Kendrick, 1969).

Arthrographis kalrai (Tewari & Macpherson) Sigler & Carmichael comb. nov.
≡ *Oidiodendron kalrai* Tewari & Macpherson 1971, Mycologia 63:602-611 (basionym)
= *Arthrographis langeroni* Cochet 1939, Ann. Parasit. Hum. Comp. 17:98-101 and pl. 3 (no Latin diagnosis)

Description

Colonies on PYE (Fig. 2A) are 22-28 mm diam. in 21 days, yellow becoming buff or tan with tan reverse, slightly raised, dome-shaped, downy or tufted becoming velvety and tough, or powdery. The surface remains smooth or develops radial ridges or folds which may crack. On cereal agar (Fig. 2B) colonies are 36-44 mm diam. in 21 days, flat, creamy white or buff, powdery, occasionally

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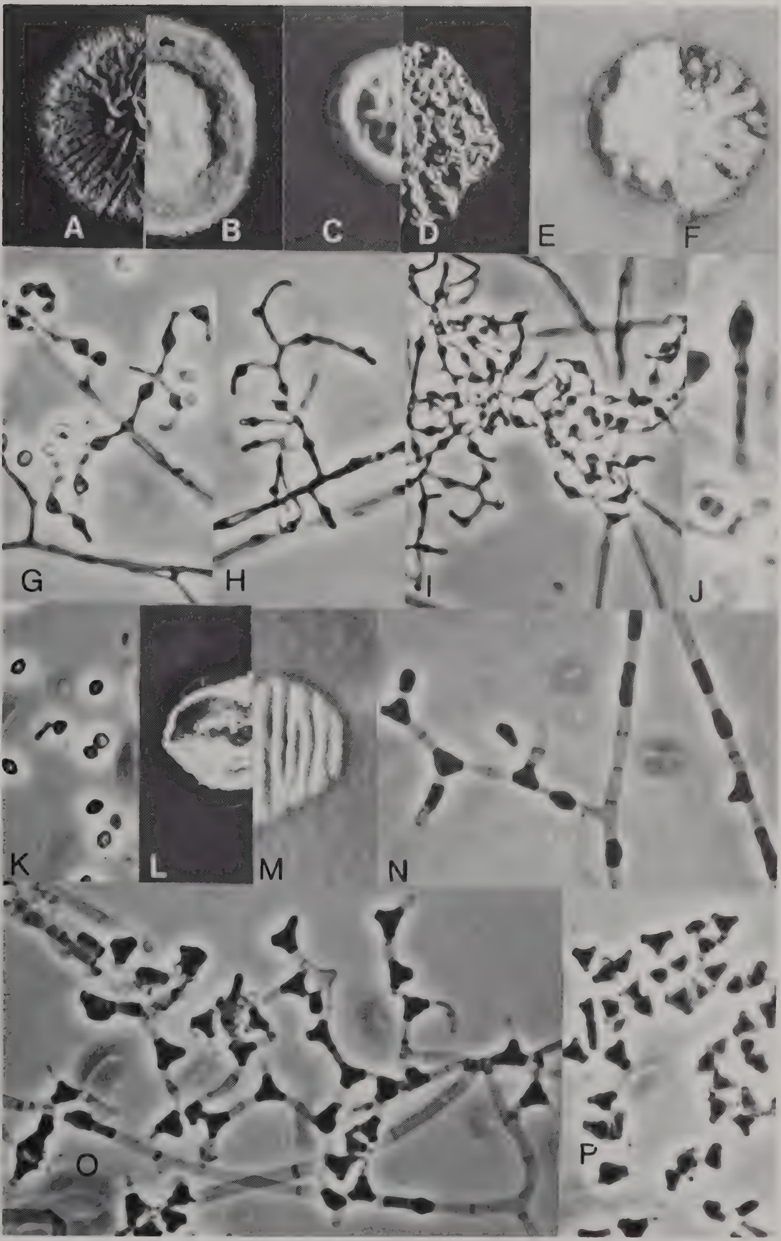
Figure 1. A-K. *Arcuadendron ovatum* (A,D,F,G,J-UAMH 2737; B,C,E,H,I,K-2746). L-P. *Arcuadendron triangularis* (3433). Figs. 1A-1F. Colonial morphology after 21 days. A-D on PYE, E and F on cereal. C and D at 37 C, rest at 25 C. Figs. 1G-1I. Conidia developing serially on curved fertile hyphae. Fig. 1J. Conidium delimited by basal septum. Fig. 1K. Mature verrucose conidia. Figs. 1L-1M. Colonial morphology after 21 days at 25C. L on PYE, M on cereal. Figs. 1N-1O. Chains of triangular conidia developing serially on undifferentiated hyphae. Fig. 1P. Mature triangular conidia. Colonies x 0.7, others x 600, except J, x 1680.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downy or woolly with tufts of upright hyphae. Growth at 37 C is slower.

Vegetative hyphae narrow, 1-3um wide. Arthroconidia, borne on short, branched conidiophores (Figs. 2C-2E), are cylindrical, hyaline, R.P. Southby, CMI 34813. smooth, thin-walled, 1.5-2 x 2.5-4.5(5)um. Longer, narrower arthroconidia also develop by fragmentation of young undifferentiated hyphae (Fig. 2F). In degenerate strains, this form may predominate.

Habitat and activity: Worldwide from soil, air, skin lesions and sputum. Keratinolytic with penetration of the hair shaft by single hyphae.

Pathogenicity: The pathogenicity of this species has been studied by Cochet (1939) and by Tewari and Macpherson (1968b, 1971). Experimental inoculation into mice (Tewari and Macpherson, 1968b; Swenberg, Koestner and Tewari, 1969) resulted in severe neurological disorder, more severe in mice inoculated intravenously than intraperitoneally. The organism was recovered from the spleen, kidney, liver, lung and brain. Tewari and Macpherson (1971) also discussed the dimorphic nature of the fungus. However, we have been unable to convert the type strain of *O. kalrai* and Cochet's strain, a somewhat degenerate isolate, to the yeast phase by the *in vitro* method outlined by them. Three morphological variants were isolated from sectors in Y-4, (ATCC 18434, UAMH 3616), the type of *O. kalrai*. All three formed mucoid colonies at 37 C, but only one (UAMH 3616c) formed a few yeast-like budding cells after multiple transfers in brain heart infusion broth (Difco). The predominant growth throughout was hyphae and arthroconidia. Arthroconidia were often seen to be germinating.

Antigenicity: Tewari and Macpherson (1968a) observed significant protection in mice challenged with *Histoplasma capsulatum* after vaccination with formalinized *O. kalrai* vaccine. Later, Tewari, Macpherson and Maitra (1969) demonstrated cross-reactive hypersensitivity between *Histoplasma capsulatum* and *Oidiodendron kalrai*.

Material Examined
From human sources: UAMH 3464, from chronic digital lesions, France, by Cochet, circa 1938, CBS strain Cochet 112.38; UAMH 3616, TYPE strain of *Oidiodendron kalrai*, from sputum of man with ill-defined respiratory ailment, India, Tewari (Y-4), ATCC 18434; UAMH 2298, also rec. as strain Y-4, listed as soil isolate, New Delhi, by Mohapatra, from Campbell, Harvard Univ.; UAMH 2610 & UAMH 2617, isolates from mixed culture also containing *Ctenomyces serratus*, rec. as Y-4, New Delhi, by Mohapatra, from Tewari, Columbus, Ohio; UAMH 2546, gastric wash specimen, Edmonton, 1965; UAMH 3380, skin of right foot (isolated on 3

occasions), from Friedman, New Orleans as 192; UAMH 3715, human source, Calif., from Orr as O-2556; From other sources: UAMH 3279, air sampling, Rabat, Morocco, by Chabert, from Nicot, Paris as 5216; UAMH 2578, CBS strain von Arx (CBS 344.49?) of Ramularia gei, possible contaminant in culture

Arthrographis cuboidea (Sacc. & Ellis) Sigler comb. nov.
≡ Oospora cuboidea Saccardo & Ellis 1882, Michelia 2:576 (Basionym)
≡ Geotrichum cuboideum (Sacc. & Ellis) Sumstine 1913, Mycologia 5:56 and pl. 83
≡ Coremiella cuboidea (Sacc. & Ellis) Ciferri & Caretta 1960, Mycopath. et Mycol. Appl. 12(3):249 and Tab. 3
= Geotrichum microsporum Smith 1962, Trans. Brit. mycol. Soc. 45(3):388-389 and Tab. 8, fig. 4
≡ Briosia microspora (Smith) von Arx 1972, Ant. v. Leeuw. 38(3):293
Excluded species: Coremiella ulmariae (McWeeney) Mason ap. Hughes ≡ Coremiella cubispora q.v.

History

In 1882 Saccardo and Ellis discovered Oospora cuboidea growing on rotting oak in Newfield, New Jersey and provided a brief description but no figures. In 1913, Sumstine examined the presumed isotype specimen and transferred the species to Geotrichum with a brief description and illustration.

In 1960, Caretta examined the isotype of O. cuboidea of Ellis (from NYBG) and proposed a new combination Coremiella cuboidea (Sacc. & Ellis) Cif. & Caretta. Included in his concept of this species were four isolates from human feces, one of which (UAMH 829), received from Caretta in 1960 as Coremiella cuboidea, has been identified as a Trichosporon, possibly T. cutaneum. Indeed, Caretta's figures strongly suggest differences between the four human isolates and O. cuboidea. In placing Coremiella ulmariae in synonymy with O. cuboidea, Caretta misinterpreted arthroconidium formation in the latter as endogenous (see also Coremiella). The isotype specimen of Oospora cuboidea (Fig. 2G) is conspecific with Geotrichum microsporum Smith. However, this species belongs neither in Geotrichum nor Coremiella; therefore, a new combination is proposed in Arthrographis.

Von Arx (1972) transferred G. microsporum to Briosia while simultaneously suggesting that Coremiella cuboidea (Sacc. & Ellis) Cif. & Car. and C. ulmariae (McWeeney) Mason apud Hughes could be conspecific with Briosia ampelophaga Cavara, the type of which he examined. However, Briosia differs from both in forming thallic meristem conidia (Kendrick, 1971, p. 168 & 251) in contrast to the fission arthroconidia of Arthrographis and the alternate arthroconidia of Coremiella (see also Briosia, Coremiella).

Description

Colonies on PYE, 50-60 mm diam. in 7 days, are pale yellow, reverse yellow, flocculent and powdery with tufts of conidiogenous hyphae over the cellophane membrane. Growth at 37 C is rapid and similar in appearance except that the reverse becomes pink or violet by 14 days. On cereal agar at 7 days, colonies are 60-70 mm diam., yellow, dense with flocculent tufts of hyphae. The reverse, at first yellow, later stains dark blue. A pink pigment diffuses into the agar. At 37 C, the colony is 25-30 mm diam. in 7 days.

Hyphae septate, hyaline, 2-5um diam. Conidiophores are scarcely differentiated, simple, hyaline, branching near the apex to form a tuft of conidiogenous hyphae. The conidiogenous hypha, delimited by a basal septum (Fig. 2H), is 80-150um long, unbranched, at first sparingly, then more regularly septate (Fig. 2H), in more or less basipetal succession. The conidiogenous hypha forms septa at regular intervals, each interval 3.5-5um wide, which further subdivide into uniform, 2-2.5um, segments (Fig. 2I). The intervening septa, appearing at first less dense, begin to form before initial septation of the conidiogenous hypha is complete (Fig. 3A), and develop randomly. Fission arthroconidia (Fig. 3B), formed in more or less basipetal succession by disjunction of the hypha, appear square or rectangular, often wider than long, discoid in end view, smooth, hyaline at first, later yellow, 1.5-2.5 x 2-3.5um.

Habitat and activities: Reported from mine timber (Smith, 1962; Fassatiova, 1971) and southern yellow pine (Pinus australis Michx.) timber (Chidester, 1940). Causes pink stain in heartwood and sapwood of pine, birch, cyprus, hemlock, spruce, fir, oak and Douglas fir (Chidester,

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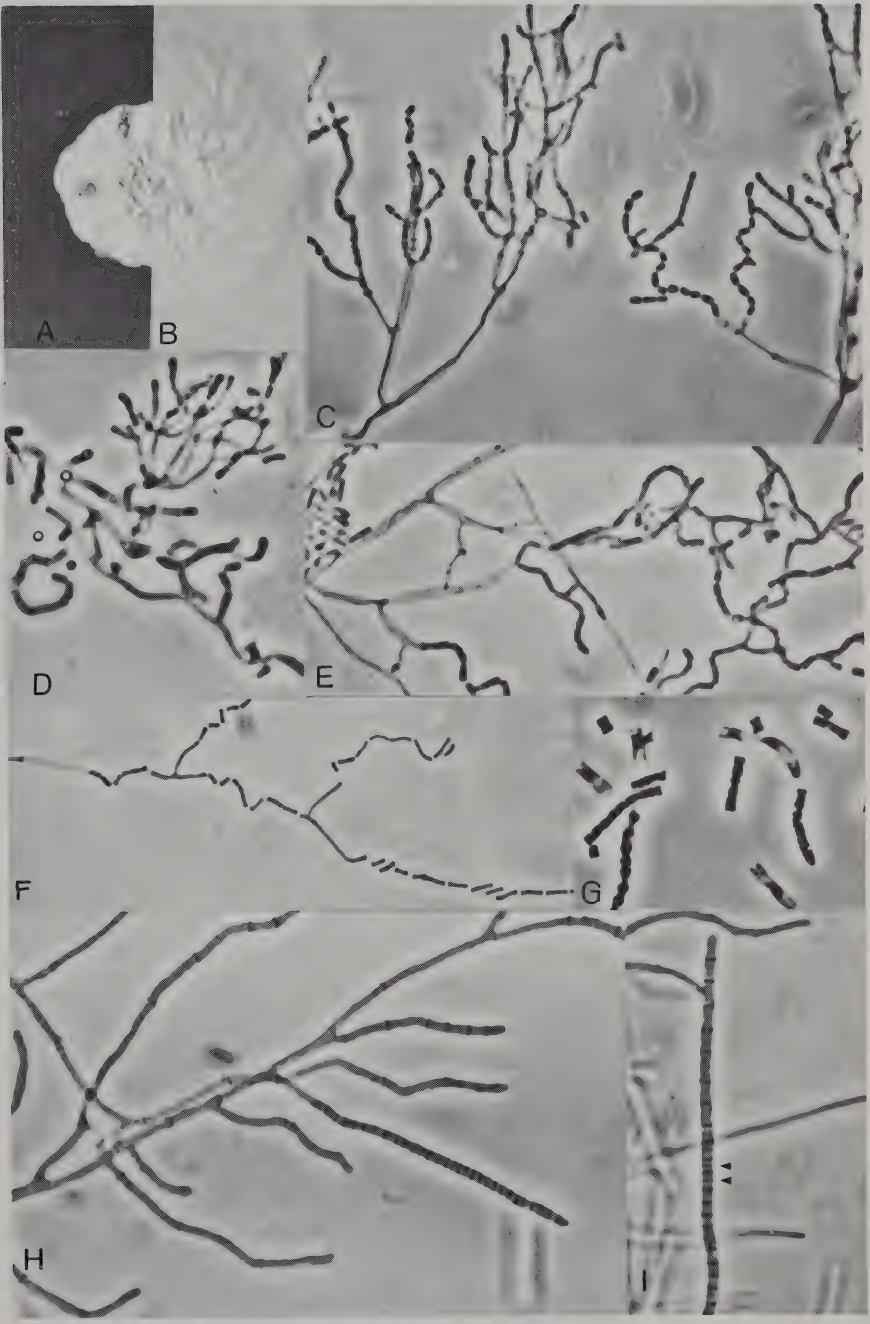
Figure 2. A-F. Arthrographis kalrai (A,B-UAMH 3616; C-2617; D-3380; E-2610; F-2578). G-I. Arthrographis cuboidea (G-3760; H,I-676). Figs. 2A-2B. Colonial morphology after 21 days at 25 C. A on PYE, B on cereal. Figs. 2C-2E. Fission arthroconidia borne on branched conidiophores. Fig. 2F. Arthroconidia formed by fission of undifferentiated hyphae. Fig. 2G. Fertile hyphae and arthroconidia of isotype specimen of Oospora cuboidea. Fig. 2H. Regular septation of conidiogenous hyphae. Fig. 2I. Subdivision of intervals by septa (arrows). Colonies x 0.7, others x 600.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1940). A. cuboidea is strongly cellulolytic.

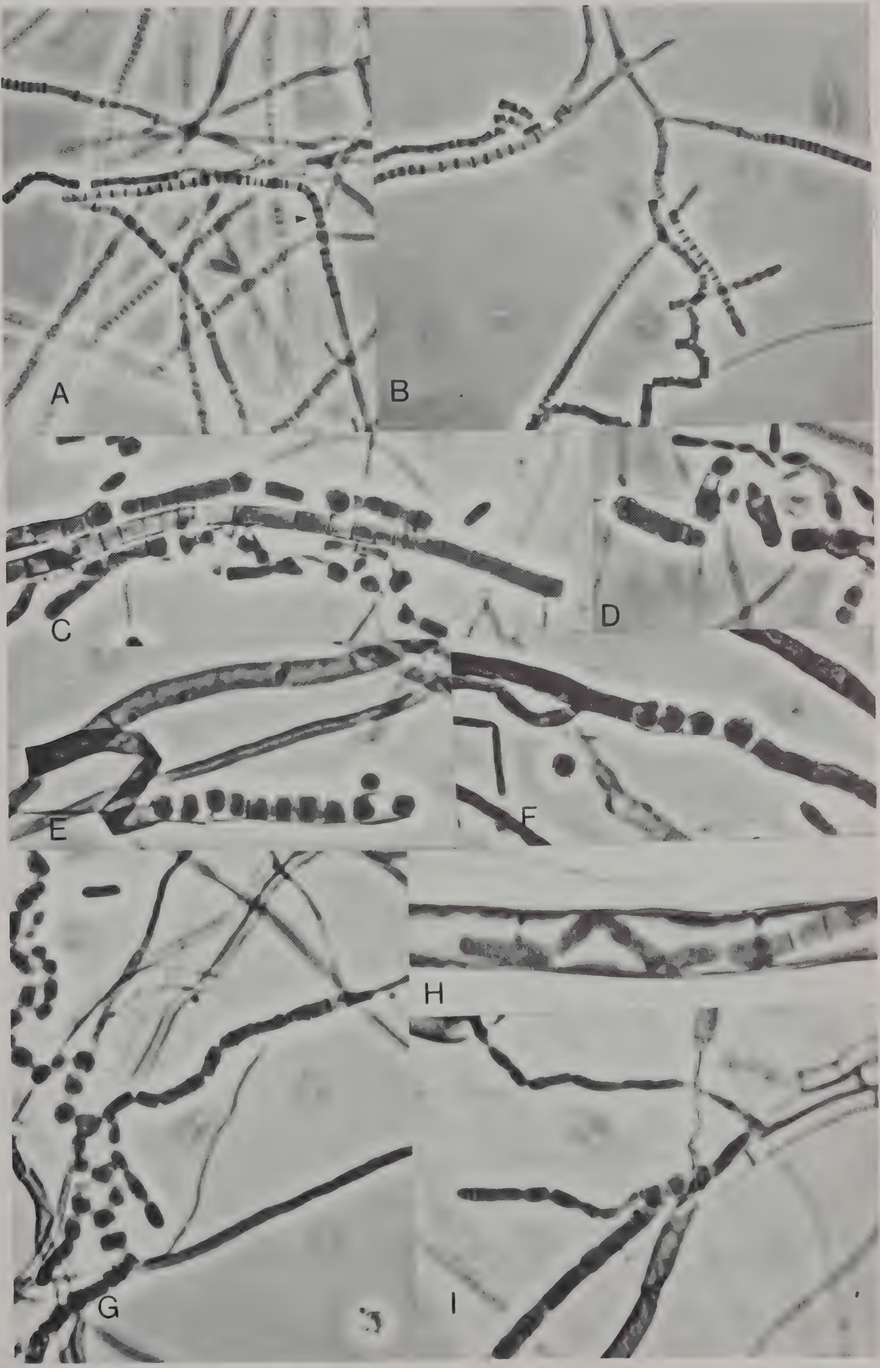
Material Examined
Oospora cuboidea, ISOTYPE, Quercus, Newfield, N.J., 1881, by Ellis (3536) from NYBG; UAMH 676, birch post, Chalk River, Ontario by Shields, 1956, DAOM 64066; UAMH 3101, TYPE strain of Geotrichum microsporum, rotten mine timber, Johannesburg, S. Africa, 1955, CMI 94091; UAMH 3792, mushroom bed, by Komatsu, 1964, from Tubaki, IFO 9190.

Bahusakala Subramanian 1958

Type Species
Bahusakala olivaceonigra (Berk. & Br.) Subramanian 1958, J. Indian Bot. Soc. 37:61-63
≡ Septonema olivaceo-nigrum Berk. & Br. 1873, J. Linn. Soc. 14:90

The following description is based mainly on CBS strain 499.66 (UAMH 3812), the only available culture of this species. Arthroconidia develop on more or less undifferentiated hyphae either terminally or in an intercalary position. Hyphae are pale brown at first, later becoming thick-walled and yellow-brown in the fertile segments. The hyphae are broad and sparingly septate, and some segments appear to have lost their cytoplasmic contents. Arthroconidia usually develop endogenously, like those of Sporendonema casei, but without separating cells. The fertile segments of the hyphae, at first sparingly septate, cleave into smaller segments (Fig. 3C) and mature arthroconidia are released by dissolution or fracture of the outer wall (Figs. 3E,3F). Remnants of the outer wall are often visible around the released conidia, and conidia occasionally remain connected by the outer wall (Fig. 3D) in groups of 2 or 3. These arthroconidia often appear somewhat verrucose. Mature arthroconidia are pale brown, smooth to verrucose, cylindrical with rounded corners, 0-1 septate, 3-6 x 5-12(16) um.

Figure 3. A-B. Arthrographis cuboidea (A-UAMH 3101; B-676). C-I. Bahusakala olivaceonigra (3812). Fig. 3A. Random development of intervening septa. Fig. 3B. Mature fission arthroconidia. Fig. 3C. Septation of undifferentiated fertile hypha. Fig. 3D. Mature conidia, remaining connected in groups of 2 or 3 by sections of the outer hyphal wall. Figs. 3E-3F. Mature arthroconidia released by dissolution or fracture of the outer hyphal wall. Fig. 3G. Fission arthroconidia formed by segmentation of undifferentiated hypha. Fig. 3H. Intrahyphal hypha fragmenting to form arthroconidia. Fig. 3I. Fragmentation of new hyphal branch after fracture of the outer hyphal wall. All x 600, except H, x 1680.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In addition to the endogenous conidia, arthroconidia also form directly by the segmentation and disjunction of segments of the fertile hypha (Fig. 3G), just as in *Scytalidium*. There appears to be no outer wall surrounding these arthroconidia. Rarely, within a broad hypha in which the cytoplasmic contents are less granular, an intra-hyphal hypha (Buller, 1933) can be observed breaking into arthroconidia (Fig. 3H). It is possible that all the endogenous arthroconidia are actually formed by fission of intra-hyphal hyphae growing within segments of the original outer wall. As arthroconidia are released from the outer wall, new branches also emerge (Fig. 3I) and this new growth is probably an extension of the intra-hyphal hypha. The extruded endohypha also divides to form arthroconidia (Fig. 3I). No other spore state was observed.

In the two herbarium specimens on plant material, the arthroconidia often remain connected by portions of the outer wall, and generally agree with the culture described above. The drawing labelled *B. olivaceonigra* by Ellis (1971, Fig. 3) shows prominent septa and other features which suggest *Scytalidium flavo-brunneum* (q.v).

Muller, Harr and Sulmont (1969) described the *Bahusakala* state of *Aulographina pinorum* (Desm.) Arx & Muller which differed from the type species in forming a sexual state and in growing on *Pinus maritima*. They described and illustrated (their Fig. 1) endogenous arthroconidium development and noted that the wall of the maturing conidium was difficult to differentiate from the outer wall of the original hypha. From their figures, the *Bahusakala* state of *A. pinorum* is very similar to our culture of *B. olivaceonigra*.

Material examined: UAMH 3812, *Mangifera indica*, CBS 499.66; UAMH 3959, photos from Herb. IMI 135080, ex type collection, *Septonema olivaceo-nigrum*, Herb. Berk. 1879, on 'Agave', Ceylon; UAMH 3974, slides from MUBL 1750 on *Yucca gloriosa*, Madras, India, C.V. Subramanian, 1956.

Arthroconidial states of Basidiomycotina

In 1889, Brefeld illustrated the conidial states of a number of Hymenomycetes, in which the hyphae divided into short segments called 'oidia'. Hughes (1953) in his experimental classification of the Hyphomycetes discussed the formation of 'oidia' by Basidiomycotina in his Section VII. This group included fungi in which the development of conidia occurred by septation and disjunction of simple or branched hyphae.

Brodie (1936) studied 'oidial' development in *Collybia velutipes* and some other Hymenomycetes. He found that the 'oidia' of *Collybia velutipes* occurred on both dikaryon and monokaryon mycelia but that clamp connections rarely occurred on the fertile branches of the dikaryon mycelium. He concluded that the 'oidia' of the dikaryon mycelium were haploid.

Nobles (1948) studying 126 species of wood rotting fungi growing in agar culture, described the 'oidia' of 13 species. Maxwell (1954) in a study of Thelephoraceae observed that 'oidia' were the most common form of asexual reproduction in the Agaricaceae and Polyporaceae of the Hymenomycetes.

In the UAMH, a number of strains, at first filed as '_Geotrichum_ _sp_.', appear to be arthroconidial states of Basidiomycotina. They do not fit our current concept of _Geotrichum_, since they have dry rather than slimy arthroconidia. These strains are characterized by rapid growth, woolly or felt-like texture, strong odor, and cellulolytic activity. Although they have not been identified, we suspect that these strains are mostly Hymenomycete monocaryons. We provide a brief description of them here to alert the user of this monograph to the existence of arthroconidial fungi which do not fit well into existing form-genera of the Hyphomycetes. Their colonial morphology is rather uniform and a combined description is provided for the colonies. However, they showed sufficient variation in the manner of arthroconidium formation to describe four different groups of strains. Although we have separated these groups in the key (as 5a to d), and have tentatively assigned the first two to _Mauginiella_, we have not studied them sufficiently to assign them definitely, or to propose names for the other groups. The distinctive conidial state of _Tyromyces_ _ptychogaster_ (Polyporaceae) is described under the form-genus _Ptychogaster_. When the arthroconidial states of Basidiomycotina have been more thoroughly studied, some additional form-genera will likely be required.

Description

Colonies on PYE (Figs. 4A,4B) grow rapidly (35-62 mm in 7 days and almost filling the petri dish by 14 days) and are white or pale tan, reverse white or yellow. Aerial growth is dry, dense, patchy, matted, woolly or downy, raised, and often more dense on cellophane than on the exposed medium. When dried, the aerial growth flattens becoming felt-like and mottled yellow or tan in color. Most strains produce a diffusing yellow pigment and occasionally copious yellow exudate. A distinct sweet odor is often apparent. Growth on cereal is slightly more rapid (60-90 mm in 7 days) but otherwise similar. The diffusing pigment turns the medium tan. Most strains do not grow at 37 C, but some show slight growth. Most are strongly cellulolytic.

a) Group 1 (Strains 448, 507, 511, 1535, 1537, 2098, 2536, 2705, 2769, 2871, 3251, 3436, 3657)

Developmentally, these strains resemble Geotrichum, but differ in having dry arthroconidia. Arthroconidia (Fig. 4D), formed by septation and disjunction of undifferentiated fertile lateral branches, are hyaline, barrel-shaped or cylindrical, single-celled, measuring 2-4(5.5) x (2)3-10(15)um. They tend to lie in zig-zag chains (Fig. 4F), and collapse easily when exposed to air. Thick-walled intercalary or terminal chlamydospores (Fig. 4C) are produced by many strains. One isolate (UAMH 2769) formed clamp connections. In most respects, these strains resemble the type species of Mauginiella, M. scaettae Cavara. However in M. scaettae, the fertile hyphae are wider than the vegetative mycelium and break up reluctantly.

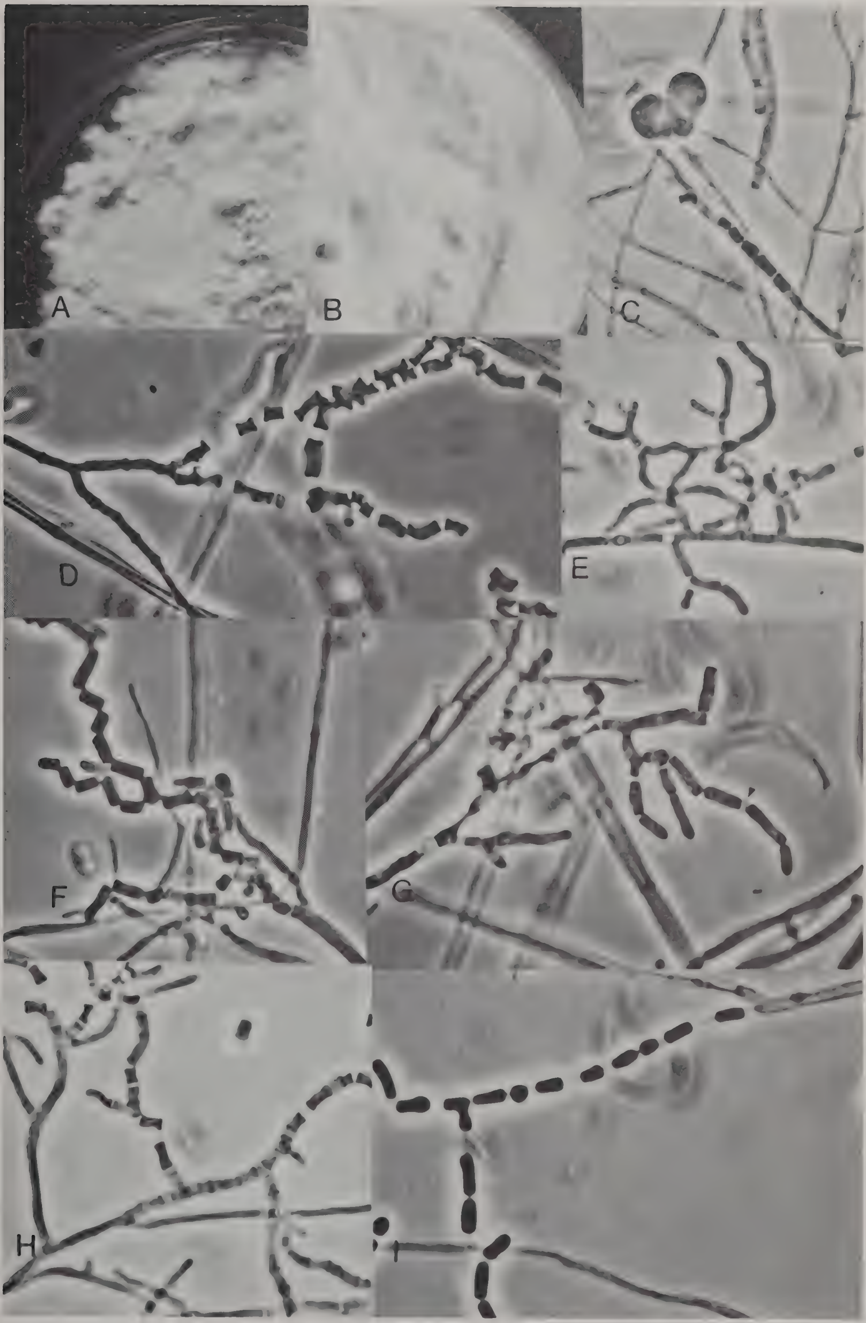
b) Group 2 (Strains 3776, 3787)

Both isolates were received as Phlebia radiata Fr. Colonies grow less luxuriantly. Arthroconidia are borne in chains on undifferentiated, often curved, lateral branches (Fig. 4E). Fission arthroconidia are hyaline, cylindrical, 2.5-4 x 4-9um. Clamp connections are present on some of the hyphae which do not break up into arthroconidia. This group differs from group 1 mainly in having curved fertile hyphae.

c) Group 3 (Strains 645, 2772, 3412)

Narrow separating cells develop between maturing arthroconidia (Fig. 4G) after septation of the fertile hypha (Fig. 4H). The connecting cell is often difficult to detect suggesting that it could be a gelatinous secretion of the maturing arthroconidia similar to that described for Oidiodendron (q.v.).

Figure 4. Arthroconidial states of Basidomycotina. A-B. Colonial morphology (A-UAMH 3251; B-511). C,D,F. Group 1 (C-1537; D-2536; F-1535). E. Group 2 (3776). G-H. Group 3 (G-3412; H-645). I. Group 4 (3796). Figs. 4A-4B. Colonial morphology on PYE after 21 days at 25 C. Fig. 4C. Thick-walled chlamydospores. Fig. 4D. Fission arthroconidia borne on undifferentiated hyphae. Fig. 4E. Fission arthroconidia borne on curved lateral branches. Fig. 4F. Mature fission arthroconidia in zig-zag chains. Figs. 4G-4H. Disjunctor cells developing between arthroconidia. Fig. 4I. Mature arthroconidia separated by collapsed disjunctor cells. Colonies x 0.7, others x 600.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d) Group 4 (Strains 514, 3796, 3837)

Of the two strains received as *Collybia conigena* (Pers. ex Fr.) Bres., one (UAMH 3837) failed to sporulate. The oidium development described by Brodie (1936) for *Collybia velutipes* (Curt. ex Fr.) Quel. is identical with this group. After growth of the fertile hypha ceases, the protoplasm of the hypha becomes condensed in segments separated by vacuoles. Then the condensed portions develop a septum at each end to become conidia. Brodie (1936) reported that transverse septa were rarely formed in the fertile hypha before condensation occurred.

This process differs from that found in *Oidiodendron* and *Sporendonema* where concentration of the protoplasm is preceded by septation of the fertile hypha. However, the partly mature arthroconidia of group 4 (Fig. 4I) resemble the alternate arthroconidia of *Sporendonema*, until the walls of the separating cells collapse. At this stage the chains of arthroconidia resemble strings of sausages (Fig. 4I). Conidia are cylindrical or rounded at the corners, or dumb-bell shaped, 2.5-4 x 5.5-13um.

Habitat: Probable contaminants in clinical material from human and animal sources; soil of sheep and horse corrals; feathers of sparrow; in Alberta, Kentucky, S. Carolina, Ohio, Kansas, Georgia, California and Czechoslovakia.

Material Examined
Collybia conigena: UAMH 3796 (CBS 146.29) and UAMH 3837 (CBS 108.13); *Phlebia radiata*: UAMH 3776 (CBS 278.29) and UAMH 3787 (CBS 285.73);
Alberta isolates from clinical specimens: UAMH 448, skin from perianal region, 1955; UAMH 507, sputum, 1956; UAMH 511, toenail, 1956; UAMH 514, blood, 1956; UAMH 645, toes, 1959; UAMH 2536, skin scrapings, canine, 1965; UAMH 3251, urine, 1969; From clinical specimens: UAMH 1535, sputum, (Orr KCFS 62-5241); UAMH 1537, sputum, (Orr KCFS 62-5706); UAMH 2705, vitreous humor of eye, Ohio, from Schwarz, Univ. of Cincinnati, Ohio; UAMH 3657, Orr-1209; From other substrates: UAMH 2098, Calif., Martin, 1961, as 840; UAMH 2769, sheep pen, Alberta, D. Remington, 1967; UAMH 2772, horse corral, Alberta, D. Remington, 1967; UAMH 2871, soil of broomsedge field, S. Carolina, 1967, from Coleman, Savannah Ecology Laboratory, S. C. as G80209; UAMH 3436, feather of house sparrow, Valtice, Czech., 1970, Z. Hubalek, (Orr 0-3279)

Briosia Cavara 1888

Type Species
Briosia ampelophaga Cavara 1888, Atti Ist. Bot. Univ. Pavia, ser 2, 1:321-322, Tab. 5

In the development of thallic meristem conidia of Briosia (Kendrick 1971, p. 168 & 251), septation occurs successively from the apex of the hypha followed by enlargement or expansion of the apical and subsequent segments. Expansion occurs only after delimitation by a septum. Mature conidia (Fig. 5A) are brown, thick-walled, globose or sub-globose or cylindrical and disarticulate by fission, at maturity, 5-7.5 x 6-11um (5-8um in diameter, fide Sutton, 1973).

In describing B. ampelophaga, Morris (1963) illustrated expansion occurring before delimitation by a septum in the manner described for Basipetospora rubra (Cole and Kendrick 1969; Kendrick 1971, p. 168). Von Arx (1972) placed Coremiella in synonymy with Briosia but Coremiella differs in forming alternate arthroconidia. (See also Arthrographis.)

Sutton (1973) noted the similarity of conidium development in Briosia and Ojibwaya Sutton. The latter differs in forming conidiophores from the basal cells of the erect funnel-like wall of the immersed stroma. The conidiophores are not borne on a synnema as in Briosia. Sutton (1973) considered Briosia ampelophaga similar to Coremium luteolum Camara apud Serafim collected from Vitis in Portugal. However he was unable to obtain type material of C. luteolum.

Habitat: Primarily on leaves of Vitis and Platonia causing leaf spot, and sometimes on fruits of Vitis vinifera Michx. Collected in Brazil, Italy, Wisconsin and Illinois.

Material examined: UAMH 3822, ex DAOM 137503, on leaves of Vitis riparia, Daneville, Illinois, by Solheim.

Other Species
Briosia azaleae (Peck) Dearness 1941, Mycologia 33:360
= Periconia azaleae Peck 1833, Ann. Rep. N.Y. State Mus. 25:93
= Sporocybe azaleae (Peck) Saccardo 1886, Syll. Fung. 4:608

According to Dearness, the arthroconidia of B. azaleae are smaller, measuring 3-7.5 x 2.75-4.5um. Furthermore, B. ampelophaga occurs commonly on grape leaves, whereas B. azaleae has been recovered from bud and twig blight of azalea (Davis, 1939).

Excluded Species
Briosia cubispora (Berk. & Curt.) v. Arx 1972
= Coremiella cubispora q.v.
Briosia cystopoides (Bubak & Krieger) v. Arx 1972
= Coremiella cubispora q.v.
Briosia microspora (Smith) v. Arx 1972

SEE ERRATA

= *Arthrographis cuboidea* q.v.

Chrysosporium Corda 1833

Type Species
Chrysosporium merdarium (Link) Carmichael 1962, Can. J. Bot. 40:1160 and figs. 30-34
= *Sporotrichum merdarium* Link 1818, Jahrb. Gewachsk. 1:176
= *Chrysosporium corii* Corda 1833, Sturm's Deutschl. Flora III (Pilze), Bd. 3, Heft. 13:85

For further synonymy and descriptions of other species of *Chrysosporium*, refer to Carmichael (1962). Chrysosporia form aleurioconidia terminally, at the ends of short or long lateral branches, or directly on the sides of the hyphae. Intercalary aleurioconidia occur in some species, and these intergrade with alternate arthroconidia. The aleurioconidia of *Chrysosporium* are broader than the diameter of the fertile hypha. *Malbranchea* differs in having non-swollen arthroconidia. *Geomyces* has distinctive, acutely branched fertile hyphae borne on erect conidiophores.

Excluded species: *Chrysosporium pannorum* (Link) Hughes 1958, Can. J. Bot. 36:749 = *Geomyces pannorus* q.v.

Coccidioides Stiles 1896

Type Species
Coccidioides immitis Stiles in Rixford and Gilchrist 1896, Johns Hopkins Hospital Report 1:209-269

C. immitis is a human pathogen that occurs in tissue in the form of globose cells which divide internally to produce a few to many endospores. These structures were at one time interpreted as asci and ascospores (see Dodge, 1935, p. 147) but no one has demonstrated karyogamy or meiosis in connection with their formation. Currently, the endosporulating cells are referred to as 'spherules'.

It seems likely that the spherules represent an unusual adaptation to parasitic growth, with multiplication by endosporulation instead of budding (as in most human pathogens) or fission arthroconidia (as in the dermatophytes). Other characters of *C. immitis* suggest that it may be a heterothallic member of the Gymnoascaceae, whose sexual state has not yet been observed (Kwon-Chung, 1969).

In culture, *C. immitis* grows as a mold and produces arthroconidia typical of the form-genus *Malbranchea*. A description of the conidial state and further discussion are given under the *Malbranchea* state of *Coccidioides immitis*.

Coremiella Bubak & Krieger 1912

Type Species
Coremiella cubispora (Berk. & Curt.) Ellis 1971, in Dematiaceous Hyphomycetes p. 33, fig. 6
≡ *Cladosporium cubisporum* Berk. & Curt. apud Berk. 1875, in Grevillea 3:107
≡ *Briosia cubispora* (Berk. & Curt.) v. Arx 1972, Ant. v. Leeuw. 38:293
= *Coremiella cystopoides* Bubak & Krieger 1912, Annal. Mycol. 10:52-53
≡ *Briosia cystopoides* (Bubak & Krieger) v. Arx 1972
= *Coremiella ulmariae* (MacWeeney) Mason apud Hughes 1953, Can. J. Bot. 31:640, fig. 94
≡ *Stysanus ulmariae* MacWeeney 1895, Irish Naturalist 4:277
Excluded species: *Coremiella cuboidea* (Sacc. & Ell.) Cif. & Car. 1960 ≡ *Arthrographis cuboidea* q.v.

Because of the detailed account provided by Ellis (1971) only a brief description is given here. Arthroconidia (Fig. 6A) are alternate, separated by one or more empty cells, smooth, thick-walled, oblong or cubical with a small papilla at each end, brown, 3.5-7 x 4-9(14)um. Mature conidia are liberated by fracture or lysis of the outer hyphal wall of the adjacent empty cell, often leaving a frill of outer wall material attached to the conidium. The fertile hyphae often show characteristic dichotomous branching (Bubak, 1912; Hughes, 1953). Conidiophores are loosely aggregated to form a coremium, hemispherical at the tip, rarely observed in culture.

Arnaud (1954) described and illustrated *Geotrichella alternata* without a Latin diagnosis. Though Kendrick and Carmichael (1973) suggest possible synonymy with *Coremiella* the status of *Geotrichella* is not clear. Tubaki (in Kobayashi *et*. *al*., 1967) described *Geotrichella arctica*, a fungus bearing considerable resemblance to *Coremiella*, but did not validate *Geotrichella*. We requested Tubaki's type specimen of *G*. *arctica* from the Institute for Fermentation, Osaka, but did not receive it.

The alternate arthroconidia of *Coremiella* distinguish this form-genus from dematiaceous fungi forming conidia by fission such as *Scytalidium*, *Briosia* and *Bahusakala*. Developmentally, *Coremiella* resembles *Sporendonema* and *Malbranchea* but differs from both in having darkly pigmented cell walls. Furthermore, the hyphae and arthroconidia of *Coremiella* are 3.5-7um wide whereas those of *Malbranchea* rarely exceed 3.5um.

Habitat and activities: Recorded worldwide on senescent and living plant material; may cause soft rot in pears (Lucas, Carvalho and Barreiro, 1974). Digests cellophane but not keratin. Grows vigorously at 30 C, but not at 37 C. On agar, releases a pigment which appears grey or brown on cereal or yellow on PYE.

Material Examined
UAMH 1165, photomicrograph, ex DAOM 35160, from Ranunculus leaf, England, det. E.W. Mason; UAMH 1513, from Picea abies, Denmark, E.W. Mason, 1949, CMI 36938; UAMH 3793, from stump of Lindera umbellata Japan, M. Ichinoe, 1966, rec. Tubaki, IFO, Japan as 8862 (NHL 4583).

Geomyces Traaen 1914

Lectotype species
Geomyces auratus Traaen 1914, Nyt. Mag. Naturvidensk. 52:28-31 and pl. IV

History

In 1914, Traaen included four species in his description of Geomyces, but failed to designate a type species. Carmichael (1962) placed all four species into synonymy with Chrysosporium pannorum (Link) Hughes. The four species of Geomyces differ primarily in color, but Carmichael (1962) noted that the color of C. pannorum can be extremely variable.

Since Traaen's culture of Geomyces auratus is still available, this species is chosen as lectotype. Geomyces differs from Chrysosporium in forming chains of conidia on acutely branched hyphae on erect conidiophores. In Chrysosporium, aleurioconidia form directly on the sides of the hypha or on short pedicels and rarely develop in chains of two or three conidia.

Generic Description

Vegetative hyphae narrow, hyaline, septate. Conidiophores narrow, hyaline, branched acutely at the apex, sometimes verticillately. Fertile branches narrow, at first sparingly, then more regularly septate. Aleurioconidia, formed terminally or laterally on short pedicels, intergrade with alternate arthroconidia. Alternate arthroconidia, broader than the fertile hypha, develop in short or long chains and may predominate. Mature conidia, released by lysis of intervening segments, are smooth or roughened, hyaline or yellow, barrel-shaped, cuneiform, subglobose or pyriform.

Geomyces asperulatus Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25 C moderatim rapide crescunt, initio roseae, posterius flavae.
Conidiophora angusta, 0.5-1.0um in diametro, ad 150um in longitudine, aliquando ramosa. Arthroconidia in catenis longis, subasperata, doliiformia, 1.5-2.5(3) x 2.5-4.5(5)um.
Typus: UAMH 183, ex solo, Harvard Forest, Waltham, Massachusetts, F. Raymond II-1-9

Colonies on PYE (Fig. 5B) are 35-39 mm in diam. in 21 days, first pale pink, flat and cottony, becoming vivid mustard-yellow, with pink and white patches at the periphery, powdery, reverse tan. The colony lifts in the center with few radial folds, and curls up at the margin with new growth appearing below. Poorly sporulating colonies (Fig. 5C) are flatter, pale yellow, hairy or bristly. On cereal, colonies (Fig. 5D) are 55 mm in 21 days, flat, with outward radiating folds, at first white then mustard-yellow, reverse the same, powdery. During sporulation, the center flattens (Fig. 5D). Brown pigment diffuses from the colony by 14 days. Poor growth at 30 C and no growth at 37 C.

The vegetative hyphae are hyaline or yellow, narrow, septate. Conidiophores are narrow, 0.5-1.0um wide, 20-150um long, hyaline, sometimes branching along the length, mostly near the apex (Figs. 5E-5G) at an acute angle. Fertile branches are narrow, 0.5-1.0um wide, at first sparingly then more regularly septate, with concentration of cytoplasm in alternate segments. Arthroconidia (Figs. 5F,5G) become thick-walled, increase in volume, and mature in long chains in more or less basipetal succession. Arthroconidia, released by lysis of the intervening empty cell, are yellow, slightly roughened, barrel-shaped or cuneiform if terminal, 1.5-2.5(3) x 2.5-4.5(5)um.

Habitat and activities: Soil, Massachusetts, Ontario and Costa Rica. Strongly cellulolytic but not keratinolytic.

Material Examined
UAMH 182, soil, Harvard Forest, Mass., F. Raymond, Farlow Herbarium as III-4-1; UAMH 183, TYPE, soil, Harvard Forest, Mass., F. Raymond, as II-1-9; UAMH 2169, Puerto Vieho, Costa Rica, from Barron, Univ. of Guelph as 10258; UAMH 2815, soil under Pinus strobus, St. Williams, Ont., G.C. Bhatt, 1967, as UW 316.

Geomyces pannorus (Link) Sigler & Carmichael comb. nov.
≡ Sporotrichum pannorum Link 1824, Linn. Spec. Plant. IV, 6(1):13 (Basionym)
≡ Chrysosporium pannorum (Link) Hughes 1958, Can. J. Bot. 36:749
= Geomyces auratus Traaen 1914, Nyt. Mag. Naturvidensk. 52:30

= Geomyces vulgaris Traaen 1914, ibid. p. 29
= Geomyces sulphureus Traaen 1914, ibid. p. 30
= Geomyces cretaceus Traaen 1914, ibid. p. 31

For full synonymy and description of G. pannorus refer to Carmichael (1962). G. pannorus is distinguished by narrow, hyaline conidiophores (Figs. 5H,5I), 0.5-1.0um wide and 10-100um long, which branch acutely near the apex sometimes verticillately. Aleurioconidia formed terminally or laterally on short pedicels intergrade with intercalary arthroconidia (Fig. 5H). Mature conidia are cuneiform, subglobose or pyriform or barrel-shaped if intercalary, hyaline, smooth or roughened, 2-4 x 2-5um, mostly 2 x 3um.

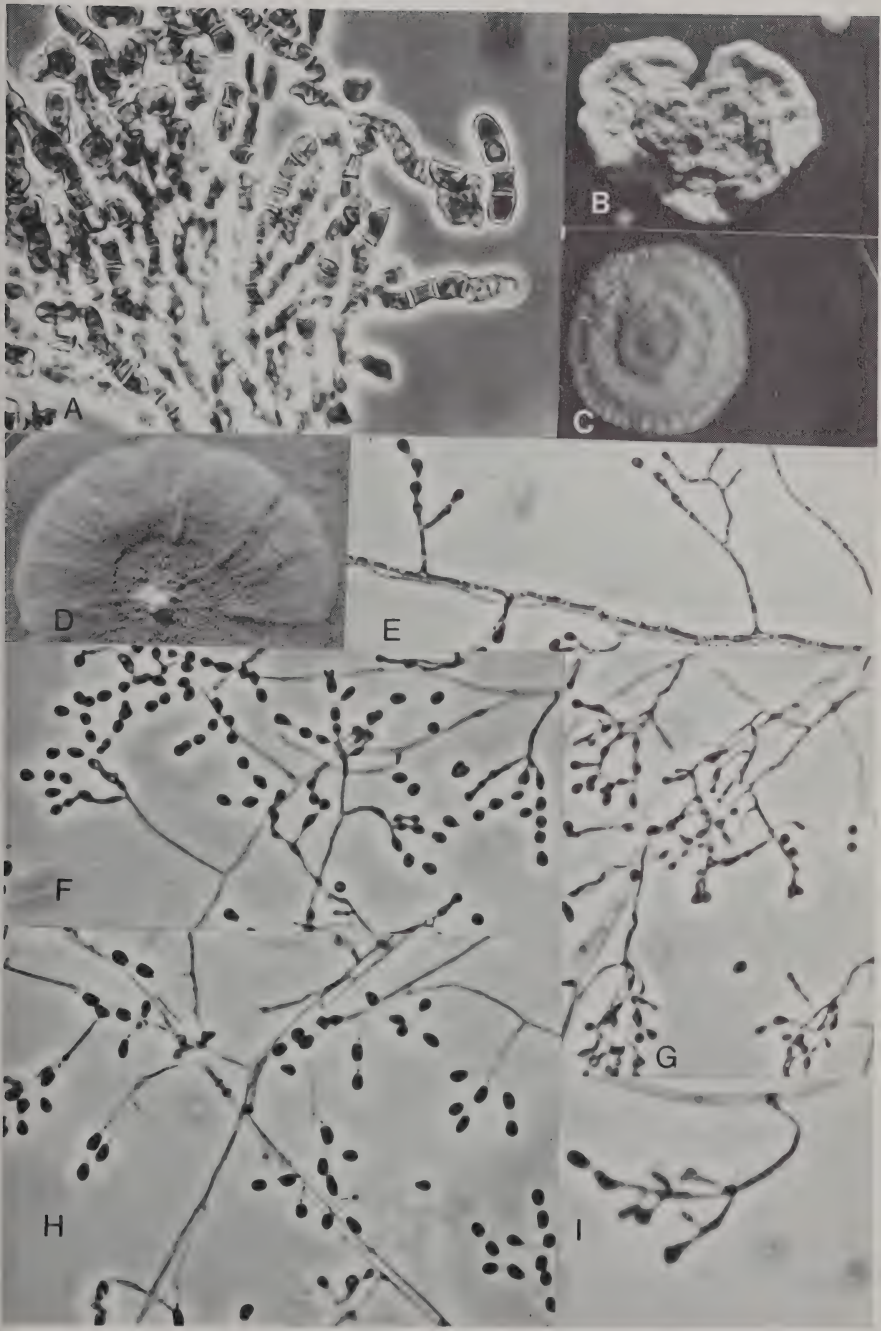
Discussion

G. pannorus differs from G. asperulatus in forming conidia in shorter chains of 2 to 4, and in forming aleurioconidia laterally on the hypha.

One of the strains examined (UAMH 3775, CBS 298.49) was received from the CBS as Onygena piligena, isolated from woollen slipper by R. Heim. The microscopic (Fig. 5I) and colonial morphology of this strain conforms with that of G. pannorus. Whether G. pannorus is the imperfect state of Onygena piligena is uncertain, although this strain was presumably isolated from ascocarps found on the natural substrate. However, no ascocarps have been produced by this strain in culture. The ascocarps of Onygena are notoriously difficult to obtain on artificial media, though Tubaki (1960) induced ascocarp formation in O. corvina by growing it on a medium enriched with owl's claw or human fingernail. Furthermore, the cellulolytic activity of this strain (UAMH 3775) suggests that it was probably a contaminant because most species of Onygena are strongly keratinolytic (Tubaki, 1960).

Habitat and activities: ubiquitous, growing well at 5-20 C (Carmichael, 1962; Williams and Pugh, 1974). Cellulolytic but not keratinolytic. Some strains penetrate the hair by single hyphae.

Figure 5. A. Briosia ampelophaga (UAMH 3822). B-G. Geomyces asperulatus (B-D,F,G-183; E-2815). H-I. Geomyces pannorus (H-2883; I-3775). Fig. 5A. Thallic meristem conidia borne on a synnema. Figs. 5B-5D. Colonial morphology after 21 days at 25 C. B and C on PYE, D on cereal. Fig. 5E. Branched conidiophores bearing chains of arthroconidia. Figs. 5F-5G. Chains of arthroconidia. Figs. 5H-5I. Aleurioconidia and arthroconidia borne on acutely branched conidiophores. Colonies x 0.7, others x 600, except I, x 1680.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Material Examined
UAMH 650, plate contaminant, 1959; UAMH 723, *Geomyces auratus*, CBS strain Traaen, TYPE or AUTHENTIC strain (CDC B-326); UAMH 1173, *Sporotrichum pannorum*, photomicrograph of TYPE specimen, ex DAOM 43320; UAMH 1561, blood transfusion flask, 1962, CBS 117; UAMH 1860, soil, Dugway, (Orr 10 DM); UAMH 2883, 2884, 2885, soil, Matador, Sask., G.C. Bhatt, 1967; UAMH 3775, woollen slipper, R. Heim, CBS 298.49 (*Onygena piligena*);

Geomyces state of *Pseudogymnoascus roseus* Raillo 1929, Zentralbl. Bakt. Parasit., Abt. 2, 78:520, fig. 2
= *Geomyces vinaceus* Dal Vesco 1957, Allionia 3:14

For a full description and synonymy of *P. roseus*, refer to Samson (1972).

Although considerable variation in colonial morphology is apparent among strains of *G. pannorus*, the sexual state, *P. roseus*, is associated only with isolates having purplish-red colonies. The *Geomyces* state of *P. roseus* is indistinguishable from *G. pannorus* microscopically. However, the purplish-red colony and presence of the sexual state, which forms readily on oatmeal agar at 18 C, distinguishes this species.

Material Examined
UAMH 1644, *Larix*, Torino, Italy, Dal Vesco, from Kuehn, Medford, N.J. as 2; UAMH 1736, same strain as 1644 from Orr as 'P.g. Dal Vesco'; UAMH 1990, soil, Wisc., (Orr QM 6969); UAMH 2005, soil, Japan, (Orr NHL 2284); UAMH 2879, soil under *Pinus contorta*, Kananaskis, Alta., P. Widden, 1967, from Bhatt, U. Calgary, Alta., as 70 (=CBS 387.69); UAMH 3001 and 3002, from Morrall, Univ. Sask., as RM 2509 (SSF176) and RM 2169 respectively; UAMH 3166, mouse dung, Claremount, Calif., R.K. Benjamin, 1965, as 1558; UAMH 3337, TYPE of *Gymnoascus rhousiogongylinus*, forest soil, Parry Sound, Ontario, H.M. Wener, 1970, from Cain, U. Toronto Herbarium, as TRTC 45536 (CBS 722.69) UAMH 3875, G.F. Orr (O-3729);

Geotrichum Link 1809

Type Species
Geotrichum state of *Endomyces geotrichum* Butler & Petersen 1972, Mycologia 64:367
= *Geotrichum candidum* Link 1809, Mag. Ges. Naturf. Freunde, Berlin 3:17
(For full description and additional synonyms, refer to Carmichael, 1957.)

The form-genus *Geotrichum* is distinguished by formation of chains of hyaline, slimy arthroconidia by segmentation of undifferentiated hyphae. Arthroconidia develop by more or less random septation and disjunction at a double septum of lateral branches or the broader vegetative hyphae which may branch dichotomously. Arthroconidia are thin-walled, smooth, cylindrical or ellipsoidal or oblong, sometimes becoming subglobose.

The developmental sequence of arthroconidium formation in *G. candidum* and the *Geotrichum* state of *Endomyces magnusii* has been recorded by time lapse photography (Cole and Kendrick, 1969). Cole (1975) described some of the ultrastructural aspects of arthroconidium formation.

Numerous species have been described in *Geotrichum*, making the taxonomy of the genus complicated and confused. For *Geotrichum candidum* alone, a species demonstrating considerable variation in culture, Carmichael (1957) lists over 50 synonyms. Furthermore, characters of many species included in *Geotrichum* are contrary to those attributed to the type species. For this reason, the following should be excluded from *Geotrichum*: dematiaceous species (see *Scytalidium*); fungi with differentiated conidiophores (see *Arthrographis* and *Oidiodendron*); species lacking fission arthroconidia (see *Coremiella*, *Sporendonema*, *Malbranchea* and *Oidiodendron*), and fungi forming blastoconidia as well as fission arthroconidia (*Trichosporon*, *Moniliella*).

However, a number of difficult problems remain. In culture, the type species, *G. candidum*, appears dry, hairy or powdery, but when disturbed the texture is slimy. This yeast-like texture is also characteristic of some other species of *Geotrichum*. If this yeast-like form of growth is a valid generic character, then fungi having dry-spored fission arthroconidia should be excluded. However, in order to exclude morphologically similar fungi (such as those described as arthroconidial states of Basidiomycotina) from *Geotrichum*, a suitable form-genus must be available for their admission. As yet, no other form-genus has been proposed to accommodate non yeast-like fungi developing hyaline fission arthroconidia on undifferentiated hyphae.

An additional problem, in assigning fungi to *Geotrichum* is defining the degree of specialization of the conidiophore. According to the definition accepted by the Kananaskis Conference on Fungi Imperfecti (Kendrick, 1971, p. 224-228), the hypha of *Geotrichum* which fragments to form arthroconidia is a simple conidiophore, 'micronematous' of Ellis (1971). However, this fertile hypha is indistinguishable from the vegetative hypha before the process of conversion begins (Cole and Kendrick, 1969). In addition, intercalary arthroconidia form in the broader vegetative hyphae (Carmichael, 1957). It is often difficult, therefore, to differentiate between an undifferentiated fertile hypha, *i.e.*, 'micronematous' conidiophore and a slightly differentiated, *i.e.*, 'semi-macronematous' (Ellis, 1971) conidiophore. Species with differentiated conidiophores are excluded from *Geotrichum* (see *Arthrographis*).

Some species that have been transferred into or out of *Geotrichum* since 1957 are listed together here for convenience.

Geotrichum fragrans (Berkhout) Morenz 1960, Taxonomie und medizinische Bedeutung der zur Gattung *Geotrichum* Link gehorenden Arten p. 178 [≡ *Oospora fragrans* Berkh.]

Geotrichum klebahnii (Stautz) Morenz [as 'klebhani'], ibid, p. 180 [≡ *Oospora klebahni* Stautz]

Geotrichum gracile (Weigmann & Wolff) Windisch 1952, Beitr. Biol. Pflanzen 29:157 ?= *Trichosporon* fide von Arx (1972)

Geotrichum ludwigii (Hansen) Sin-Fang, Tzu-cheng & Jing-chu 1966, Acta Microbiol. Sin. 12:69 [≡ *Oospora ludwigii* Hansen]

Geotrichum robustum Sin-Fang, Tzu-cheng & Jing-chu 1966, Acta Microbiol. Sin. 12:73

Geotrichum state of *Endomyces magnusii* Ludwig 1886, Ber. Deut. Bot. Ges. 4:17
For a description, refer to von Arx (1972).

Excluded Species

Geotrichum amycelicum Redaelli & Ciferri 1935, Arch. fur Mikrobiol. 6:60 = *Trichosporon cutaneum* fide Lodder (1970)

Geotrichum cinnamomeum (Libert) Saccardo 1886, Michelia 2:636
Saccardo's description and the study of Quinta (1968) suggest that this species may be identical to *Wallemia sebi* (Fr.) von Arx.

Geotrichum cuboideum (Sacc. & Ellis) Sumstine ≡ *Arthrographis cuboidea* q.v.

Geotrichum dulcitum (Berkh.) Windisch 1952, Beitr. Biol. Pflanz. 29:156 = *Protendomycopsis domschii* Windisch 1965, Beitr. Biol. Pflanz. 41:337 = *Protendomycopsis dulcita* (Berkh.) Gams & Domsch 1969, Nova Hedwigia 18:20
Although proposing a new combination, Gams and Domsch treat this species under *Trichosporon cutaneum*. Lodder (1970) lists *P. domschii* as a synonym of *Trichosporon cutaneum*.

Geotrichum flavo-brunneum Miller *et al.* 1957
= *Scytalidium flavo-brunneum* q.v.

Geotrichum hirtum Windisch 1952, Beitr. Biol. Pfanzen 29:157 = *Trichosporon cutaneum* fide Lodder (1970)

Geotrichum microsporum Smith 1962 = *Arthrographis cuboidea* q.v.

Geotrichum purpurascens (Bon.) Sacc. 1886 = *Sporendonema purpurascens* q.v.

Geotrichum roseum Grove 1886 ?= *Sporendonema purpurascens* q.v.

Geotrichum rotundatum (Cast.) Cif. & Red. 1929 = *Trichosporon cutaneum* fide Lodder (1970)

Geotrichum rugosum (Cast.) Dodge 1935, Medical Mycology p. 219 = *Trichosporon cutaneum* fide Lodder (1970).

Geotrichum suaveolens (Lindner) Cif. apud Diddens & Lodder 1942, in Die anaskosporogen Hefen II:271 = *Moniliella suaveolens* (Lindner) von Arx 1972

Geotrichum vanriji Saez 1964, Bull. mens. Soc. linn. Lyon 33(7):266 = *Trichosporon cutaneum* fide Lodder (1970)

Malbranchea Saccardo 1882 See Part II

Mauginiella Cavara 1925

Type Species
Mauginiella scaettae Cavara 1925, Atti della R. Acc. dei Lincei 322, ser. 6, p. 67
= *Geotrichum scaettae* (Cavara) Maire 1937, in Maire & Werner, Mem. Soc. Sc. Nat. Maroc 45, p. 133

A single strain was examined. The colony on PYE is 60 mm diam. in 14 days, creamy, flat, dense and downy or felt-like when dried. The reverse is yellowish-tan, with some areas of darker pigment. Growth is slightly slower at 30 C and considerably slower at 18 C (40 mm in 21 days). Colonies on cereal are similar, but with distinct yellow pigment in the aerial growth at 18 C.

The vegetative mycelium consists of a few straight regular hyphae, 3-5um wide, and many narrow, curved, irregular branches 2-3um wide. The fertile hyphae are regular, branched and 4-7um wide. They quickly become filled with dense cytoplasm and closely septate, but break up only slowly into fragments (sometimes branched) with

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zero to many septa. The individual cells are 6-15um long. We received this strain too late to include it in the plates, but drawings of the arthroconidia are provided by Nicot (1972).

The colonies of *M. scaettae* resemble those described under Arthroconidial states of Basidiomycotina. Microscopically, *M. scaettae* is close to group 1, but differs in its wider fertile hyphae and incomplete disarticulation.

Habitat and activities: Causes a rot of date palm inflorescences (Nicot, 1972). Cellulolytic, not keratinolytic.

Material examined: UAMH 3098, from *Phoenix dactylifera*, Iraq, 1949, CMI 34813

Oidiodendron Robak 1932

Perfect States: *Myxotrichum* Kunze, *Byssoascus* von Arx

Lectotype Species
Oidiodendron tenuissimum (Peck) Hughes 1958, Can. J. Bot. 36:790
≡ *Periconia tenuissima* Peck 1893, N. Y. State Museum Report 46:113 (Basionym)
= *Oidiodendron fuscum* Robak 1932, Saetryk av. Nyt. Mag. Naturvidensk 71:251

This wood- and soil-inhabiting fungus forms arthroconidia on branched or unbranched, hyaline fertile hyphae borne at the apex of a pigmented conidiophore. Occasionally, conidiophore production is suppressed and arthroconidia form directly on undifferentiated fertile hyphae.

The exact mode of development of its arthroconidia is not completely understood. Barron (1962), in his monograph of nine species, reported that arthroconidia were formed either endogenously, remaining connected within the original outer hyphal wall until maturity, or more commonly, by segmentation of the hypha with each developing conidium drawing slightly apart from its neighbors, but remaining connected to them by a gelatinous secretion.

Cole and Kendrick (1969), in a time-lapse study of *O. truncatum*, concurred with the latter view. They found that initial septation, possibly by double septa, was followed by rounding up and drawing apart of the immature arthroconidia leaving a clear area between adjacent conidia. The clear areas, termed connectives, were often traversed by a septum. Cole and Kendrick (1969) agreed with Barron (1962) that the connectives were either remnants of the outer hyphal wall left after endogenous formation of conidia, or more probably, that they were gelatinous secretions from the maturing conidia. The presence of a septum within the connectives suggested that new terminal end walls distinct from the original septum were formed by the maturing arthroconidium. In a further discussion, Kendrick (1971, p. 162) designated this type of arthroconidium development as type 2. Recently, Cole (1975) suggested that the connectives between conidia may be deposits of new wall material formed around the septum.

Arthroconidia of Oidiodendron, separated from each other by gelatinous connectives, are distinct from the fission arthroconidia of Geotrichum and Arthrographis and the alternate arthroconidia of Malbranchea and Ovadendron. Oidiodendron is further distinguished by its pigmented conidiophores.

For discussions of the species of Oidiodendron, the reader is referred to Barron (1961, 1962), Morrall (1968), Cole and Kendrick (1969), Kobayasi et. al. (1969), Kiffer, Mangenot and Reisinger (1969) and Tokumasu (1973). In addition, Oidiodendron conidial states have been described for Myxotrichum cancellatum [= Toxotrichum cancellatum] (Orr and Kuehn, 1964a; Apinis, 1964), Arachniotus flavoluteus (Muller and Pacha-Aue, 1968) and Byssoascus striatosporus [= Arachniotus striatosporus] (Barron and Booth, 1966; von Arx, 1971). However, in our examination of the type strain of A. flavoluteus (UAMH 3531, CBS 627.71, NRRL 1243), we were unable to confirm the presence of an Oidiodendron conidial state. Nor have Kuehn and Orr (1959), Udagawa (1963), or von Arx (1971) reported an asexual state for this species.

Oidiodendron state of Myxotrichum striatosporum

Perfect State:
Myxotrichum striatosporum (Barron & Booth) Sigler comb. nov.
= Arachniotus striatosporus Barron & Booth 1966, Can. J. Bot. 44:1060 (Basionym)
= Byssoascus striatisporus (Barron & Booth) von Arx 1971, Persoonia 6(3):377

Barron and Booth (1966) described this species in Arachniotus as having white confluent gymnothecia composed of narrow, hyaline peridial hyphae and fusiform, striate yellow ascospores. In their preliminary discussion, however, they noted that darkly pigmented hyphae occurred in association with the gymnothecia, but did not include their description in the Latin diagnosis. Von Arx (1971) removed the species from Arachniotus and proposed a new genus, Byssoascus, because of the fusiform, striate

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ascospores.

There appears to be little justification for the creation of a new genus for this fungus. On the basis of ascospore morphology alone, this species does not differ from species of Myxotrichum which have ellipsoidal or fusiform ascospores. Ascospores of some species, such as M. deflexum and M. chartarum (Orr, Kuehn and Plunkett, 1963b; Apinis, 1964; Visset, 1974) also have longitudinal furrows which are clearly visible when the ascospore is seen in polar view at high magnification. The ascospores of M. striatosporum are more definitely striate but this character would not exclude the species from Myxotrichum.

The primary reason for the removal to Byssoascus would seem to have been the nature of the gymnothecium, which is composed of thin-walled, narrow hyphae. Examination of the type strain (UAMH 3572 and 3758, CBS 642.66, CMI 115998) revealed that production of ascospores was consistently associated with the formation of dark brown, thick-walled, smooth hyphae, often aggregated into ropes (Fig. 6D). On cereal agar, ascospores are produced beneath the surface of the colony among the thick-walled hyphae. No discrete gymnothecium or peridial wall was seen. Species of Myxotrichum have been described in which the gymnothecia coalesce and do not detach readily from the vegetative hyphae (see Malbranchea circinata, Myxotrichum setosum).

The transfer to Myxotrichum is proposed for several reasons. First, the ascospore shape and surface, the Oidiodendron conidial state and the cellulolytic activity of the fungus are consistent with those of other species of Myxotrichum. In addition, the dark brown, thick-walled, coalescing hyphae (Fig. 6D) are branched and often have blunt tips where the terminal portion has broken off (Fig. 5E). This severance of the tip of branches is seen frequently in species of Myxotrichum. Finally, the similarity of M. striatosporum to M. setosum suggests that

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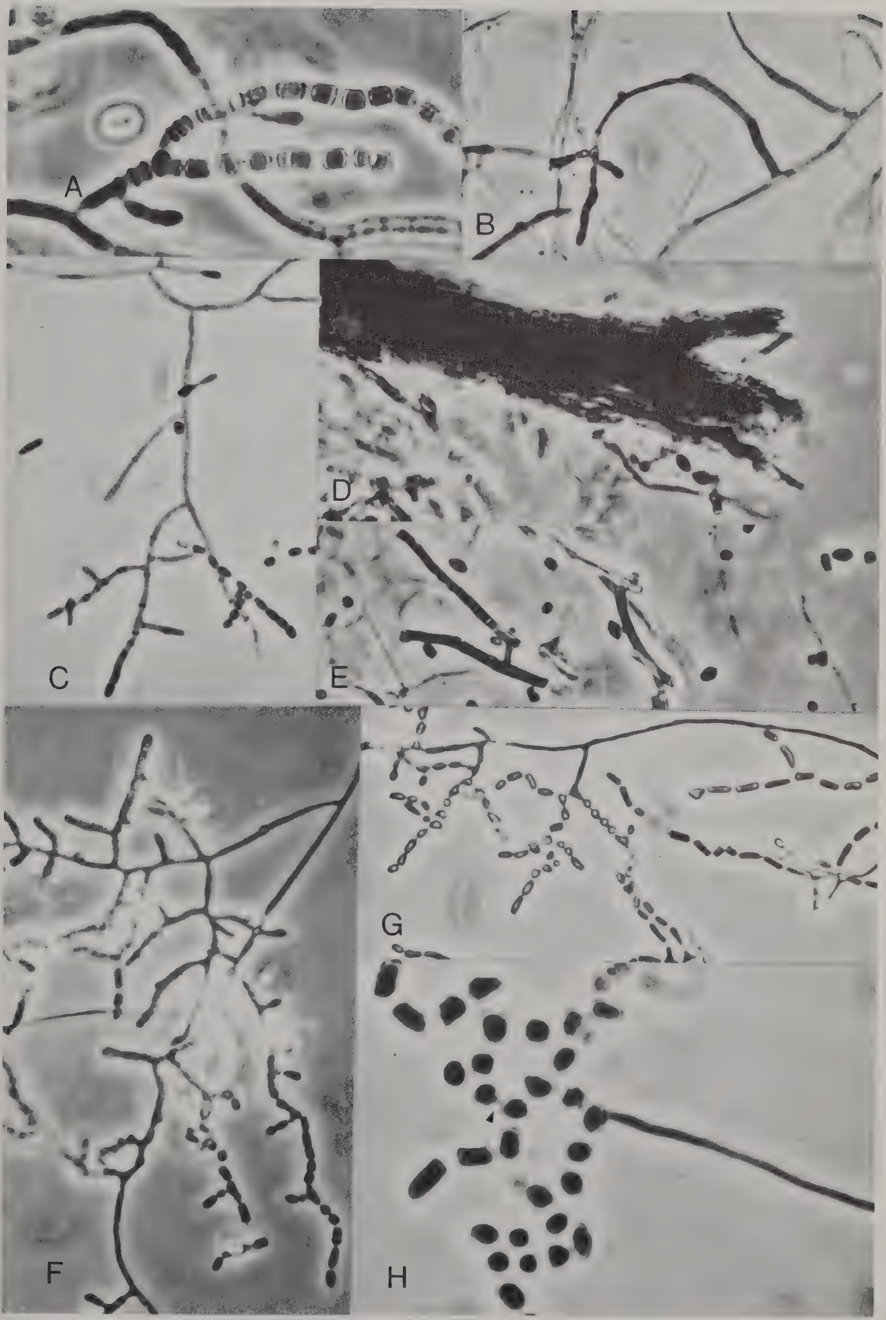
Figure 6. A. Coremiella cubispora (UAMH 3793). B-E. Oidiodendron state of Myxotrichum striatosporum (B,D,E,-3572; C-3578). F-H. Oidiodendron state of Myxotrichum setosum (3835). Fig. 6A. Alternate arthroconidia borne on dichotomously branched hyphae. Fig. 6B. Arthroconidia borne on pigmented conidiophore. Fig. 6C. Arthroconidia borne on hyaline conidiophore. Fig. 6D. Dark brown 'peridial' hyphae aggregated into ropes, and fusiform ascospores. Fig. 6E. Ascospores and segments of peridial hyphae showing blunt tipped branches. Figs. 6F-5G. Arthroconidia borne on hyaline conidiophores. Fig. 6H. Septum (arrow) traversing connective between adjacent arthroconidia. All x 600, except H, x 1680.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these two species should be placed in the same genus.

The *Oidiodendron* state of *M. striatosporum* is similar to the *Oidiodendron* state of *M. setosum*. On cereal agar, the conidiophores of *M. striatosporum* are narrow, mostly hyaline (Fig. 6C), rarely becoming pigmented at the base (Fig. 6B). Arthroconidia are often formed directly on undifferentiated hyphae. Arthroconidia are smooth or slightly rough-walled, olive-green, barrel-shaped 1.5-2.5 x 1.5-3.5um. Barron and Booth (1966) noted that the barrel-shaped arthroconidia differed from those of other species which were mostly ovoid, globose or cylindric.

The colonial morphology of *M. striatosporum* also resembles that of *M. setosum*. *M. striatosporum* grows slowly on both PYE and cereal. On cereal, the colony is 22 mm in diam. at 14 days, flat, slightly zonate, velvety, dark olive-green with characteristic bright yellow margin, reverse brown. On PYE, the colony is pale olive, adhering poorly to the cellophane and lifting up at the margin.

Oidiodendron state of *Myxotrichum setosum* (Eidam) Orr & Plunkett, in Orr *et. al*. 1963b, Can. J. Bot. 41:1457-1480
?= *Oidium microspermum* Berkeley & Broome 1873, in Ann. Mag. Nat. Hist. 4, ser. II, 346
= *Oospora microsperma* (Berk. & Br.) Saccardo & Voglino 1886, Syll. Fung. 4:22

History

Berkeley and Broome (1873) described *Oidium microspermum* from bark of Scotch fir (*Abies*) with a brief description but no illustration. Saccardo and Voglino (in Saccardo, 1886) transferred *O. microspermum* to *Oospora*. Lindau (1907) described the fungus from an exsiccatum, No. 1577 of Rabenhorst's Fungi europae, from *Lonicera xylosteum*. Since we have seen neither illustrations nor the type specimen of *Oidium microspermum* no new combination is proposed for the conidial state. However, both specimens that were examined had been identified as *Oidium microspermum* by Hughes (DAOM 37243) and Pirozynski (DAOM 144716). One of these (DAOM 144716) formed a perfect state in culture which agreed with previous descriptions of *M. setosum*. Therefore, *Oidium microspermum* is listed as a probable synonym of the *Oidiodendron* state of *M. setosum*.

Eidam first reported *Gymnoascus setosus* in 1882 from an isolate on a wasp's nest, with a brief description and no illustration. In 1902, Massee and Salmon found *G. setosus* on a bee's nest in England. They noted the distinctive white centrum of the ascocarp, and provided an excellent illustration (See Figs. 7D,7E). Dale (1903) reported germinating the ascospores from Massee and

Salmon's specimen, but she observed only a few hyphae and masses of blastoconidia in culture on a variety of media. Perhaps she was dealing with a contaminant.

DeLamater (1937), comparing *G. setosus* with *Eidamella spinosa* [= *Myxotrichum deflexum*], concluded that the two species were distinct, disagreeing with Dodge's (1935) placement of *E. spinosa* into synonymy with *G. setosus*. Apinis (1964) concurred with DeLamater.

Orr and Plunkett (in Orr *et. al.*, 1963b) proposed a new combination, *Myxotrichum setosum* (Eidam), based on the description and figures of Massee and Salmon (1902) and Dale (1903) and the original description of Eidam (1882). Orr and Plunkett were unable to find a type specimen or any recent isolates of *G. setosus*. Despite Dale's detailed account of the conidial state, they reported the asexual state to be unknown. Apinis (1964) examined Massee's original drawings (NY) of *M. setosum* as well as two specimens from bee hives. He described the conidial state as 'oidia', 2 - 3um wide.

The conidial state of *M. setosum* has not previously been referred to *Oidiodendron*, probably because conidiophore development is weak and conidiophores remain unpigmented. Arthroconidia often develop on undifferentiated hyphae. These are probably the 'oidia' described by Apinis (1964). The conidial state of *M. setosum* described by Dale (1903) is more difficult to interpret.

Description

The colony on PYE at 25 C is 17 mm in diam. at 21 days, pale olive, reverse tan, velvety, adhering poorly to the cellophane. The margin becomes undulate and the center lifts. On cereal, the colony is flatter, stretching to 22 mm at 21 days with slightly raised center, powdery, dry and cracked, olive-green with 1-2 mm wide pale yellow margin, buff reverse. Psychrophilic, producing the sexual state at 8 C.

Vegetative hyphae are hyaline, septate, narrow. Conidiophores (Figs. 6F,6G) are hyaline, narrow, 1-1.5um wide and 30-140um long, branching at the apex to form fertile hyphae. Arthroconidia develop in more or less basipetal succession on the fertile branches (Fig. 6F) or on undifferentiated hyphae. Arthroconidia, becoming slightly rounded, remain linked by connectives often traversed by a septum (Fig. 6H). Arthroconidia are olive with thickened walls (Fig. 6H), smooth, mostly cylindrical, sometimes subglobose or ovoid, 1.5-2 x 3-5um.

Homothallic. Gymnothecia confluent, not discrete.

.EE ERRATA

Peridial hyphae (Fig. 7A) not anastomosed, composed of dense, dark brown, septate, thick-walled hyphae terminating in long spines (Fis. 7A,7D) bearing two or three short lateral spines, often opposite to each other (Fig. 7D). Ascomatal initials are coiled (Fig. 7B); asci are hyaline, evanescent, subglobose, 6-7um in diameter. Ascospores (Figs. 7C,7E,7F) are pale green, smooth, fusiform or navicular, with one face flattened, 1.5-2 x 3.5-6.0um.

Discussion

Massee and Salmon's description (1902) and figures (reproduced here as Figs. 7D,7E) correspond well with the fungus described here. These authors noted that the centrum containing asci remained permanently white. In young cultures, this is true, but as the ascospores mature, the centrum becomes greenish-yellow in color.

The characteristic feature of M. setosum noted by Dale (1903) was the sharply pointed, branched spines of the peridial hyphae, which did not anastomose to form a discrete gymnothecium. The dark brown peridial hyphae and fusiform ascospores suggest that this species is correctly placed in Myxotrichum.

Placement of the conidial state in Oidiodendron is most suitable for the present. Although the conidiophores are hyaline, the development of arthroconidia resembles that of other species of Oidiodendron, especially the Oidiodendron state of M. striatosporus. If similar conidial fungi are discovered which lack the pigmented conidiophores of Oidiodendron then erection of a new form genus could be justified. Indeed, Paden (1975) reported that the conidial state of the ascomycete, Cookeina sulcipes (Berk.) Kuntze, formed arthroconidia separated by connectives similar to the type described for Oidiodendron truncatum by Kendrick (1971, p. 162). However, Paden did not describe the nature of the conidiophore.

Habitat and activities: Wood of Picea glauca, soil of Alpine regosol, Alberta, nests of wasps and bees, and honey-comb of bees, England and Germany. Neither keratinolytic nor cellulolytic.

Material Examined
UAMH 1174, photomicrograph ex DAOM 37243, from Picea glauca det. Hughes; UAMH 3835, washed soil particles from Alpine regosol, Kananaskis, Alta., 1968-1972, det. Pirozynski, DAOM 144716 (Bissett, JB 922); UAMH 3939, ex IMI 471, beehive comb, Kew, 1945, H.A. Dade.

Oidium Link 1824 nom. cons. 1975

The complicated and controversial history of the use of the name *Oidium* was reviewed by Weresub (1973) who made two proposals for its conservation. Her first proposal (371), to conserve the name *Oidium* for the conidial states of Erysiphaceae, was approved by the Special Committee for Fungi and Lichens (Taxon 24:534, 1975) reporting to the XII International Botanical Congress, Leningrad. The conidia of *Oidium* are meristem arthroconidia, formed in basipetal succession on a continuously elongating conidiogenous cell (see Kendrick, 1971, p. 168).

Excluded species: *Oidium microspermum* Berkeley & Broome 1873, in Ann. Mag. Nat. Hist., ser. II, 4:346 ?= *Oidiodendron* state of *Myxotrichum setosum* q.v.

Oospora Wallroth 1833

Eleven original species, including the type species of four other genera, were included in *Oospora* by Wallroth (Fl. Crypt. Germ. 2:182, 1833). Numerous species have since been added to *Oospora*, a nomen illegitimum (Hughes, 1958). Correct identification of many species of *Oospora* is impeded by inadequate descriptions which often lack illustrations. Examination of type specimens would be the only way of determining the correct placement for many names in *Oospora*.

Oospora crustacea Saccardo 1882, Michelia 2:545 ?= *Sporendonema casei* q.v.

Oospora cuboidea Saccardo & Ellis 1882, Michelia 2:576 = *Arthrographis cuboidea* q.v.

Oospora microsperma (Berk. & Br.) Saccardo & Voglino 1886, Syll. Fung. 4:22 ?= *Oidiodendron* state of *Myxotrichum setosum* q.v.

Oospora sulphureo-ochracea van Beyma 1933, Zentralbl. Bakter. Parasit. 88:134 = *Ovadendron sulphureo-ochraceum* q.v.

Ovadendron Sigler & Carmichael gen. nov.

Diagnosis
Deuteromycotina, Hyphomycetes. Hyphae hyalinae, septatae, angustae. Conidiophora absunt. Arthroconidia pluria, alternata, conspicue crassiora quam hyphas conidiogenas, 0-septata, in catenis longis, hyalina, laevia. Per dissolutiones cellularum separantium liberantur.
Ab *Malbranchea* per arthroconidia crassiora quam hyphas differat.
Typus: *Ovadendron sulphureo-ochraceum* (van Beyma) Sigler et Carmichael comb. nov.

Vegetative hyphae narrow, hyaline, septate. Fertile branches narrow, at first sparingly, then more regularly septate in more or less basipetal succession. Alternate arthroconidia are broader than the fertile hypha and develop in long chains. Mature conidia, released by lysis of intervening segments, are smooth, hyaline, barrel-shaped.

Developmentally, Ovadendron resembles Malbranchea. However, the species of Malbranchea compose a rather homogeneous group in which the width of the arthroconidium rarely exceeds that of the fertile hypha. In contrast, the arthroconidia of Ovadendron show a definite increase in volume, reaching a diameter of 2 or 2.5 times that of the fertile hypha. The swelling of the arthroconidium as it matures distinguishes the genus from Malbranchea.

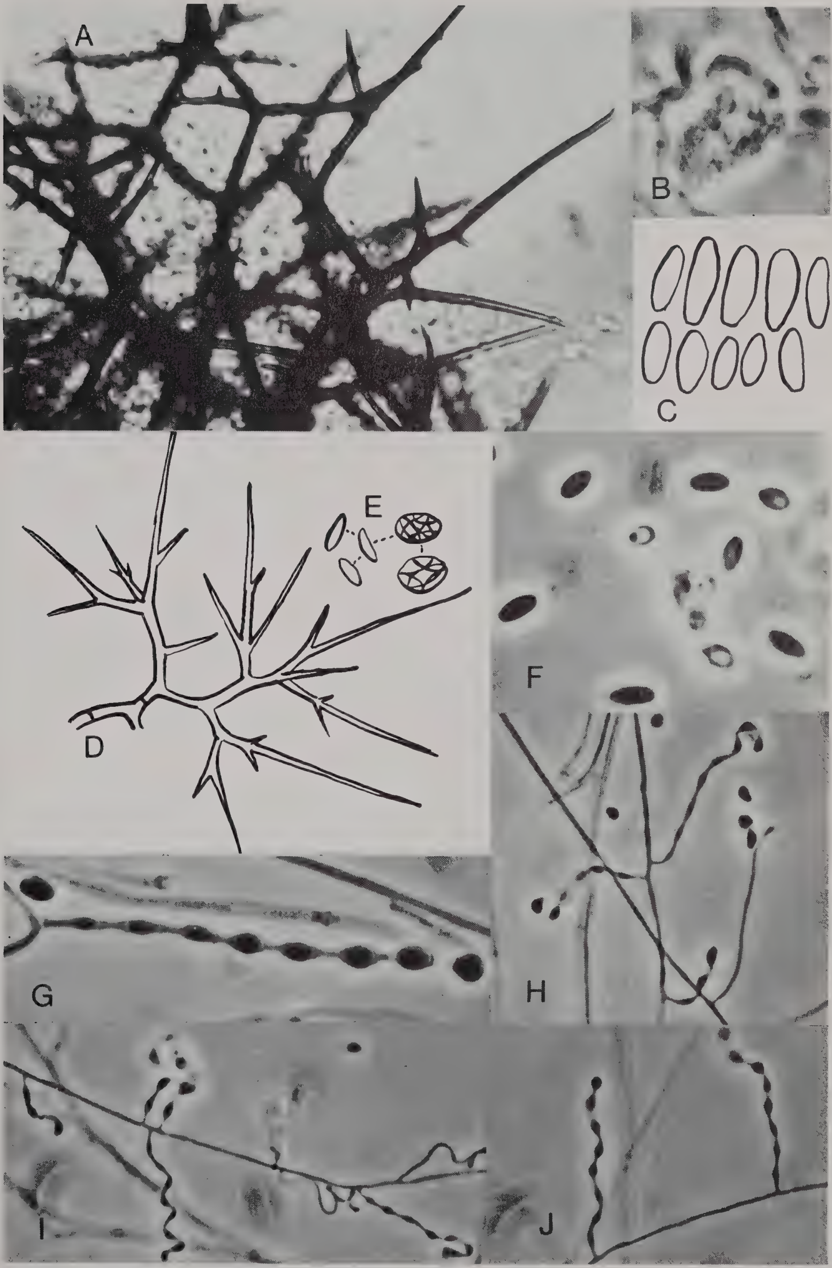
Ovadendron sulphureo-ochraceum (v. Beyma) Sigler & Carmichael comb. nov.
= Oospora sulphureo-ochracea van Beyma thoe Kingma 1933, Zentralbl. f. Bakt. u. Parasit., 2 Abt., 88:134 (Basionym)

The colony on PYE is 30 mm in diam. in 14 days, white, reverse tan, center downy and slightly raised, margin flat, glabrous. On cereal, flat (35 mm diam. in 14 days), white, floccose, reverse tan.

Vegetative hyphae are hyaline, septate, narrow. Fertile hyphae are narrow, 0.5-1.0um wide, short, coiled, lateral branches (Figs. 7G-7J) which become regularly septate, with concentration of cytoplasm in alternate segments. The arthroconidia mature in more or less basipetal succession, becoming thick-walled, and enlarging in volume. The mature, barrel-shaped arthroconidia (Fig. 7G), released by dissolution of the alternate empty segments, are hyaline, smooth 2-2.5 x 2.5-4um. No arthroconidia develop by segmentation of the vegetative hyphae.

The single strain examined (UAMH 181) corresponds to

Figure 7. A-F. Myxotrichum setosum (A-C,F-UAMH 3835). G-J. Ovadendron sulphureo-ochraceum (181a). Fig. 7A. Coalescing dark brown sharply pointed spines of peridial hyphae, x 600 BF. Fig. 7B. Coiled ascomatal initials, x 1680. Fig. 7C. Ascospores, x 1970. Fig. 7D-7E. Illustration of Massee and Salmon (1902) showing peridial hyphae (x 300) and ascospores (x 730). Fig. 7F. Ascospores, x 1680. Fig. 7G. Developing arthroconidia showing marked increase in volume, x 1680. Figs. 7H-7J. Arthroconidia in chains on coiled lateral branches, x 600.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van Beyma's original description, except that UAMH 181 remains white, whereas van Beyma noted that the colony became yellowish in age.

Activity: keratinolytic, penetrating hairs by single hyphae.

Material examined: UAMH 181, ? TYPE strain, ex CBS strain van Beyma, rec. 1954, and CBS 233.32 rec. 1975.

Ptychogaster Corda 1838

Type Species
Ptychogaster state of *Tyromyces ptychogaster* (Ludwig) Donk 1933, Meded. Bot. Mus. Herb. Rijks Univ. 22:153
= *Ptychogaster fuliginoides* (Pers. ex Steudel) Donk 1972, Proc. K. Ned. Akad. Wet. C 75:165-177
    ≡ *Trichoderma fuliginoides* Pers. 1801, Syn. Meth. Fung., p. 231
= *Ptychogaster albus* Corda 1838, Icon. Fung. II:23-24, Taf. XII, fig. 90
    ≡ *Ceriomyces albus* (Corda) Saccardo 1888, Syll. Fung. 6:388

Perfect State:
Tyromyces ptychogaster (Ludwig) Donk 1933, Meded. Bot. Mus. Herb. Rijks Univ. 222:153
    ≡ *Polyporus ptychogaster* Ludwig 1880, Zeitschr. ges. Naturwiss. III, 5:424-431
= *Oligoporus ustilaginoides* Brefeld 1889, Untersuch. aus dem Gesammtgeb. der Mykol., Heft 8:114-142, Taf. VII, fig. 23-25 and Taf. VIII, fig. 26-33

According to von Arx (1973), the fungus described by Corda as *Ptychogaster albus* was transferred by Saccardo (1888) to *Ceriomyces*. Brefeld (1889), including it in *Oligoporus* as *O. ustilaginoides*, provided excellent illustrations of the *Ptychogaster* state. These illustrations appear identical to an isolate (UAMH 3813, WFPL 170AD) received as *Ptychogaster albus*, from *Picea*, Nova Scotia.

Development of conidia in the *Ptychogaster* state of *T. ptychogaster* resembles that of *Arcuadendron*. Conidia are formed in chains, with the conidiogenous cells occurring serially, developing from the apex of the newly formed conidium (Figs. 8A,8B). The former differs, however, in forming clamp connections between the developing conidia (Fig. 8B). Mature conidia are yellow, smooth, ellipsoidal, ovoidal or barrel-shaped, 4-5 x 6-9um, released by lysis of the intervening hypha.

Conidia of *Ptychogaster rubescens* Boudier develop in the same manner. For a description of *P. rubescens*, refer to Fidalgo (1958) and von Arx (1973).

Ptychogaster species are conidial states of species of the Polyporaceae. In nature, the *Ptychogaster* stage grows as cushion shaped sporodochia, or small pads, composed of hyphae and powdery masses of conidia, or grows within the basidiocarp (Corda, 1838; Brefeld, 1889; Rea, 1922 p. 660; Donk, 1933; Davidson, Campbell and Weber, 1942; Davidson, Christensen and Darley, 1945; Fidalgo, 1958; Singh, Singh and Bakshi, 1961).

Habitat: On wood of various types including *Pinus*, *Abies*, *Picea*, and mine timber wood, South Africa, Germany, Canada, India and the USA.

Scytalidium Pesante 1957

The form-genus *Scytalidium* is characterized by dematiaceous intercalary or terminal arthroconidia formed by fragmentation of undifferentiated hyphae. The arthroconidia are thick-walled, smooth, occasionally verrucose in age, 0-1 septate, pale to mid-brown, or yellowish brown, cylindrical, oblong or broadly ellipsoidal, and if septate, often constricted at the septum. Fission arthroconidia of a second type are hyaline, thin-walled, smooth, cylindrical, single-celled. (Also refer to Ellis, 1971.) In its thallic ontogeny, *Scytalidium* resembles *Geotrichum* and *Mauginiella* but differs in being dematiaceous.

KEY TO THE SPECIES OF *Scytalidium*

1. Both hyaline and dematiaceous arthroconidia present .. 2
1. Only dematiaceous arthroconidia present 4
2. Colonies tan, grey or black .... *S. lignicola*
2. Colonies paler 3
3. Colonies white, turning grey .... *S. album*
3. Colonies yellowish .... *S. aurantiacum*
4. Colonies slow-growing, dark grey-brown *S. acidophilum*
4. Colonies growing rapidly 5
5. Colonies peach-brown or pale grey; arthroconidia brown with refractile hyaline apices; pycnidia absent .... *S. flavobrunneum*
5. Colonies grey-black; arthroconidia brown; pycnidia sometimes present ....*S.* state of *Hendersonula toruloidea*

Recently, Kuhlman, Carmichael and Miller (1976) described *Scytalidium uredinicola* which differs from other species of *Scytalidium* in growing in aecia of *Cronartium fusiforme* and in the regular swelling of its arthroconidia in culture.

Type Species
Scytalidium lignicola Pesante 1957, Ann. sper. Agr. (Roma) 11, suppl. CCLXI-CCLXV

Growth on PYE (Fig. 8C) is rapid, 70-90 mm diam. in 14 days, at first white, then dark tan, pale or dark grey, front and reverse; flat with raised radial folds, downy or woolly, dense, matted. Brown or black pigment is excreted into the agar. The type culture (UAMH 1506) forms large dark brown exudate droplets. On cereal agar (Fig. 8D), colonies are 80-90 mm in 14 days, flat, at first glabrous with reddish-tan surface growth, gradually turning black as sporulation commences and forming a loose weft of white cottony aerial growth. Aerial growth is scant. The diffused pigment is plum or grey. UAMH 2816 grows faster than the type culture (UAMH 1506) and forms dense black colonies resembling a coating of thick tar on the cellophane membrane. No growth at 37 C.

Hyphae septate, hyaline, becoming brown. Arthroconidia of one type, formed by fragmentation of hyaline hyphae (Figs. 8E,8G) are cylindrical, thin-walled 2 x 4.5-8um. Arthroconidia of the second type (Figs. 8F,8G) arising in chains in an intercalary or terminal position on short, lateral branches, become thick-walled, yellowish-brown, broadly ellipsoidal, oblong, or barrel-shaped, 0-1-septate, constricted at the septum, and show an increase in volume. Arthroconidia measure 4-7 x 7.5-12um if 0-septate, and 12-17um long if 1-septate. Arthroconidia are not readily detached and may appear surrounded by a brown slime. (See also Ellis, 1971).

Habitat and activities: Isolated from blue stain of wood of *Platanus*, *Pinus*, *Picea*, *Abies*, *Betula*, *Populus* and *Arachis*, and from soil and roots of *Vitis*, in Italy, Sweden, southern USA, Canada, Japan, Cyprus, England, India, Rhodesia (Shields, 1969; Ellis, 1971; Murao, Oda and Matsushita, 1973; Klingstrom and Johanssen, 1973) and also from rhizosphere of *Trifolium alexandrinum*, Pakistan (Hussain and Malik, 1972). Slightly cellulolytic, not

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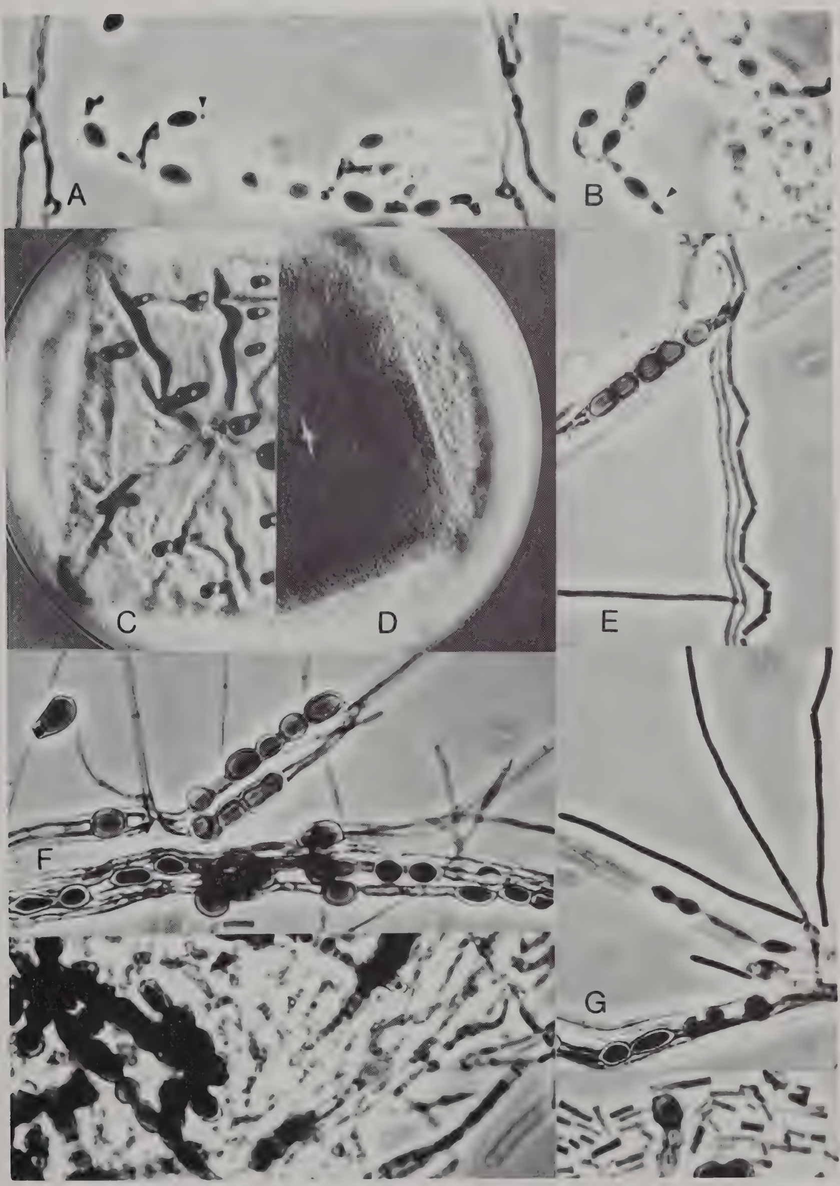
Figure 8. A-B. *Ptychogaster* state of *Tyromyces ptychogaster* (UAMH 3813). C-G. *Scytalidium lignicola* (1502). H-I. *Scytalidium album* (H-3611; I-3620). Figs. 8A-8B. Chains of conidia developing serially (arrow) and forming clamp connections between each conidium. Figs. 8C-8D. Colonial morphology after 21 days at 25 C. C on PYE, D on cereal. Fig. 8E. Hyaline arthroconidia formed by fragmentation of undifferentiated hypha. Fig. 8F. Chains of thick-walled brown arthroconidia. Figs. 8G-8I. Mature arthroconidia of both types. Colonies x 0.7, others x 600.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keratinolytic.

Klingstrom and Johanssen (1973), testing the antagonistic properties of several isolates of S. lignicola against Fomes annosus, Polyporus versicolor, Lentinus lepideus, and Coniophora puteana, found that S. lignicola overgrew all isolates, killing the decay fungi in the process.

Material Examined
UAMH 385, photomicrographs ex DAOM 59090, from presumed type; UAMH 1502, TYPE, from Platanus wood, Italy, by Pesante and Peyronel, 1956, CMI 62532 (CBS 233.57); UAMH 2816, from cornfield soil, Bright, Ontario, G.C. Bhatt, 1967, as UW. 655.

Scytalidium album Beyer & Klingstrom 1965, Sv. Bot. Tidskr. 59(1):35

Colonies grow rapidly (50 mm on PYE and 70 mm on cereal at 14 days) and are white, flat, downy or glabrous. During sporulation, surface growth on cereal turns grey, grey pigment diffuses into the medium, and orange pigment forms near the center. On DSA, the diffused pigment is bright lemon-yellow. The arthroconidia (Figs. 8H,8I) are difficult to distinguish from those of S. lignicola (Figs. 8E-8G) and S. aurantiacum.

Klingstrom and Beyer (1965) and Klingstrom and Johanssen (1973) distinguish S. album from S. lignicola by its moderate growth at 25 C, and its inability to grow at 35 C, by its whitish colored colonies and pale yellow pigmentation on malt agar, and its antagonistic properties.

Habitat and activity: Isolated from blue stain of wood of Betula, Acer, Populus, Pinus, Abies, Picea, and Pseudotsuga (Douglas fir) utility poles, in Sweden, Finland, eastern Canada and western USA (Klingstrom and Beyer, 1965; Ricard and Bollen, 1968; Klingstrom and Johanssen, 1973). Moderately cellulolytic, not keratinolytic.

Antibiotic activity and metabolites: Klingstrom and Johanssen (1973), studying the action of S. album against four decay fungi, found that inhibition resulted from a soluble substance excreted into the medium. Production of a yellow pigment was associated with antagonistic ability, but the pigment itself had no antibiotic activity. The active agent was extracted from culture filtrates of S. album and found to be inhibitory to Fomes annosus.

One of the S. album strains studied by Klingstrom and Johanssen (1973) was the FY strain (UAMH 3620) of Ricard and Bollen (1968). Considerable interest has been generated in the metabolites produced by this strain.

Ricard and Bollen (1968) reported inhibition of the wood decay fungus Poria carbonica and some bacteria by culture filtrates. Stillwell, Wall and Strunz (1973) isolated and defined the structure of scytalidin, a second antiobiotic compound active against a wide variety of fungi. In addition to scytalidin, other antibiotic agents were present in culture filtrates, active against some fungi where scytalidin was not.

Findlay and Kwan (1973 a,b) defined another major metabolite, scytalone (3,6,8 -trihydroxytetralone) and a minor one (6,4,8 -dihydroxytetralone), neither of which were inhibitory to any significant degree. Similarly, Geigert, Stermitz and Schroeder (1973) isolated two other compounds, hexenophenones, neither inhibitory to Poria carbonica.

Material Examined
UAMH 3611, TYPE, from Norway spruce, Garpenberg, Sweden by Klingstrom and Beyer, 1963 (FF28), CBS 372.65; UAMH 3620, from heartwood of Pseudotsuga utility poles, western Oregon, by Ricard and Bollen (FY), from Wang, N.Y. State Univ., Syracuse as 1041.

Scytalidium aurantiacum Klingstrom & Beyer 1965, Sv. Bot. Tidskr. 59(1):35

Colonies grow moderately rapidly (40 mm on PYE and 65 mm on cereal at 14 days). On PYE, colonies are pale yellow, flat, woolly, coarsely matted or bristly. A lemon yellow pigment diffuses into the agar on PYE and DSA. Microscopically similar to S. lignicola and S. album.

Klingstrom and Beyer (1965) and Klingstrom and Johanssen (1973) distinguish S. aurantiacum from S. lignicola by its slower growth at 25 C and its inability to grow at 35 C. S. aurantiacum differs from S. album in the yellow-red color of the colonies and visible spots apparent on malt agar. S. aurantiacum is antagonistic to some human pathogenic bacteria (Klingstrom and Beyer, 1965), and to a number of wood decay fungi (Klingstrom and Johanssen, 1973).

Habitat and activities: pulpwood of Pinus, Betula, Picea, Sweden (Klingstrom and Johanssen, 1973). Cellulolytic but not keratinolytic. Penetrates hairs by single hyphae.

Material examined: UAMH 3612, TYPE, from pulpwood of Pinus silvestris at Skinnskatteberg, Sweden, by Klingstrom and Beyer (FF21), 1962, CBS 374.65.

Scytalidium acidophilum Sigler & Carmichael 1974, Can. J. Microbiol. 20(2):267-268

Sporulation and growth is enhanced on acid media. Colonies grow slowly (21-26 mm in 21 days on cereal agar) and are dark grey-brown, reverse dark grey, furrowed, cracked with a thin velvety nap. Scant growth at 37 C.

Arthroconidia formed in extended chains (Fig. 9A), not easily detached, brown, thick-walled, smooth or verrucose in age, 0-1-septate, measuring 4.5-6.5(8) x 7-13(16)um if single-celled and 4.5-6.5(8) x (10)11.5-23um if two-celled. Arthroconidia are broadly ellipsoidal, cylindrical or irregularly shaped, and if septate, constricted at the septum.

Habitat and activities: Isolated from acid soil near sulfur stockpiles, uranium mine drainage water, and acid solutions containing 4% copper sulfate from an industrial plant, Canada and U.S.A. (Sigler and Carmichael, 1974; Starkey and Waksman, 1943). Tolerant to extreme acidity and high concentrations of copper (Starkey and Waksman, 1943; Starkey, 1973; Gould, Fujikawa and Cook, 1974). Sensitivity to copper increases as the pH approaches neutrality (Starkey, 1973). Neither cellulolytic or keratinolytic.

Scytalidium flavo-brunneum (Miller, Giddens & Foster)
Sigler comb. nov.
= *Geotrichum flavo-brunneum* Miller, Giddens, & Foster
1957, Mycologia 49:792, figs. 5-7 (Basionym)

Colonies on PYE, growing rapidly (70 mm in 14 days), are effuse, velvety, peach or salmon becoming brown, reverse dark yellow, adhering poorly to the cellophane developing radial folds, or lifting at the periphery. No growth at 37 C. On cereal agar, colonies fill the petri dish by 14 days and are flat with small central umbo and few outward radiating folds, effuse, velvety, with dark grey aerial hyphae, yellow surface growth and droplets of yellow exudate. The medium turns yellow or orange from diffusing pigment. On DSA, the pigment is bright yellow.

Arthroconidia form in chains on lateral branches (Figs. 9B,9C); conidiophores are absent. Fertile branches formed on hyaline vegetative hyphae, become regularly septate with a concentration of cytoplasm. The septa are strongly refractile. At disjunction, the conidia (Fig. 9D) are cylindrical, truncate or oblong, swollen, brown with prominent refractile apices (Figs. 9D,9E), predominately single-celled and measure 3.5-5 x 5.5-12(22)um. Ellis' (1971) Figure 3, labelled *Bahusakala olivaceonigra*, appears to be *S. flavo-brunneum* or a similar species.

In old cultures, *Monochaetia*-like conidia were occasionally formed on small compact masses of hyphae. These conidia are fusiform-curved, smooth, 3- to 5-septate, 5-6 x 15-20(25)um (Fig. 9F). The center cells are brown; the apical and basal cells are pale, each with a single hyaline appendage 0.5 x 7-8um. It is interesting that the other species of *Scytalidium* with prominent, refractile septa (the *Scytalidium* state of *H. toruloidea*) also has a second conidial state with fusiform phragmoconidia.

Habitat and activity: soil, Georgia and Wyoming (Miller *et. al.*, 1957; Boeck *et. al.*, 1975). Moderately cellulolytic but not keratinolytic.

Antibiotic activity: Boeck *et. al.* (1975) reported antifungal activity of culture filtrates from an organism which they called *Geotrichum flavo-brunneum*. In assessing the antibiotic activity of the fungus, the authors observed that no other *Geotrichum* was known to produce antifungal agents. Because of its dematiaceous nature, *G. flavo-brunneum* has been transferred to *Scytalidium*, a genus having several other species which also produce antibiotics.

The antibiotic agent, isolated and characterized as an azasteroid (Michel *et. al.*, 1975) was found to have one major and six minor components. The major component was active against several pathogenic fungi, including *Candida albicans* and *Trichophyton mentagrophytes*, but minimally inhibitory to bacteria (Gordee and Butler, 1975).

Material Examined
UAMH 617, from Pfizer and Co., 1958, (? same strain as UAMH 3487); UAMH 3487, TYPE, from forest soil, Clarke Co., Ga., J.H. Miller, 1956, CMI 100715.

Scytalidium state of *Hendersonula toruloidea* Nattrass 1933, Trans. Brit. mycol. Soc. 18:197
= *Exosporina fawcettii* Wilson 1947, Hilgardia 17(12):427, fig. 2

The arthroconidial state of *Hendersonula toruloidea* is frequently recovered from moribund tissues of fruit and trees in warm climates. Nattrass (1933) isolated the arthroconidial state from die-back disease of stone fruit trees in Egypt and reported development of pycnidia only after prolonged growth on wood. He described the arthroconidial state as characteristic of *Torula*.

Wilson (1947), comparing a fungus isolated from branch wilt disease of Persian walnut with two others from damaged citrus trees in California, noted the similarity of his isolate to *H. toruloidea* but failed to find pycnidia. He described a new species, *Exosporina fawcettii*. Later Wilson (1949) induced pycnidial formation in wood experimentally inoculated with *E. fawcettii*, and concluded that *E. fawcettii* was the conidial state of *H. toruloidea*.

Oudemans (1904) created the genus Exosporina for a single species, E. laricis, which he found on twigs and needles of Larix decidua. He described conidia developing in chains from a stroma. Immature conidia at the base of the chain were cubical, whereas mature conidia at the apex were more rounded. His description and illustrations suggest that the conidia may be thallic meristem conidia. Exosporina resembles Ojibwaya (Sutton, 1973), reported on stems of juniper. The Scytalidium state has been previously described but not named by Hughes (1952, 1953).

Recently, H. toruloidea has been recovered from infections of the skin and nails in humans (Gentles and Evans, 1970; Campbell, Kurwa, Abdel-Aziz and Hodgson, 1973; Campbell, 1974). Most infections were reported in former natives of tropical countries now residing in Great Britain. Pycnidia have rarely been observed in isolates from human infections (Gentles and Evans, 1970; Campbell, 1974) although Campbell et. al. (1973) reported that 5 of 8 isolates eventually developed pycnidia. Campbell (1974) induced pycnidial formation in 2 of 25 isolates by exposing them to ultra-violet irradiation.

Description

The Scytalidium state is characterized by dark grey-black, effuse, rapidly growing colonies often forming thin, upright ropes of hyphae. Chains of arthroconidia develop on undifferentiated, broad (4-7um), brown hyphae (Fig. 9H), often surrounded by a brown slime, or narrower (3-4um) lateral branches (Figs. 9G,9I). The septa are almost as strongly refractile as those of S. flavo-brunneum. Arthroconidia (Fig. 9H) are 0-1-septate, smooth-walled, brown, at first cylindrical-truncate, rapidly rounding up and becoming barrel-shaped or subglobose, 3.5-5 x 6.5-15um (2.5-7 x 2.5-10(15)um of Campbell, 1974). For a more detailed description, refer to Campbell (1974).

The pycnidial state has been described by Nattrass (1933), Wilson (1949) and Hughes (1952). The single isolate examined by us (UAMH 3770) first formed pycnidia after exposure to ultra-violet light. During the process

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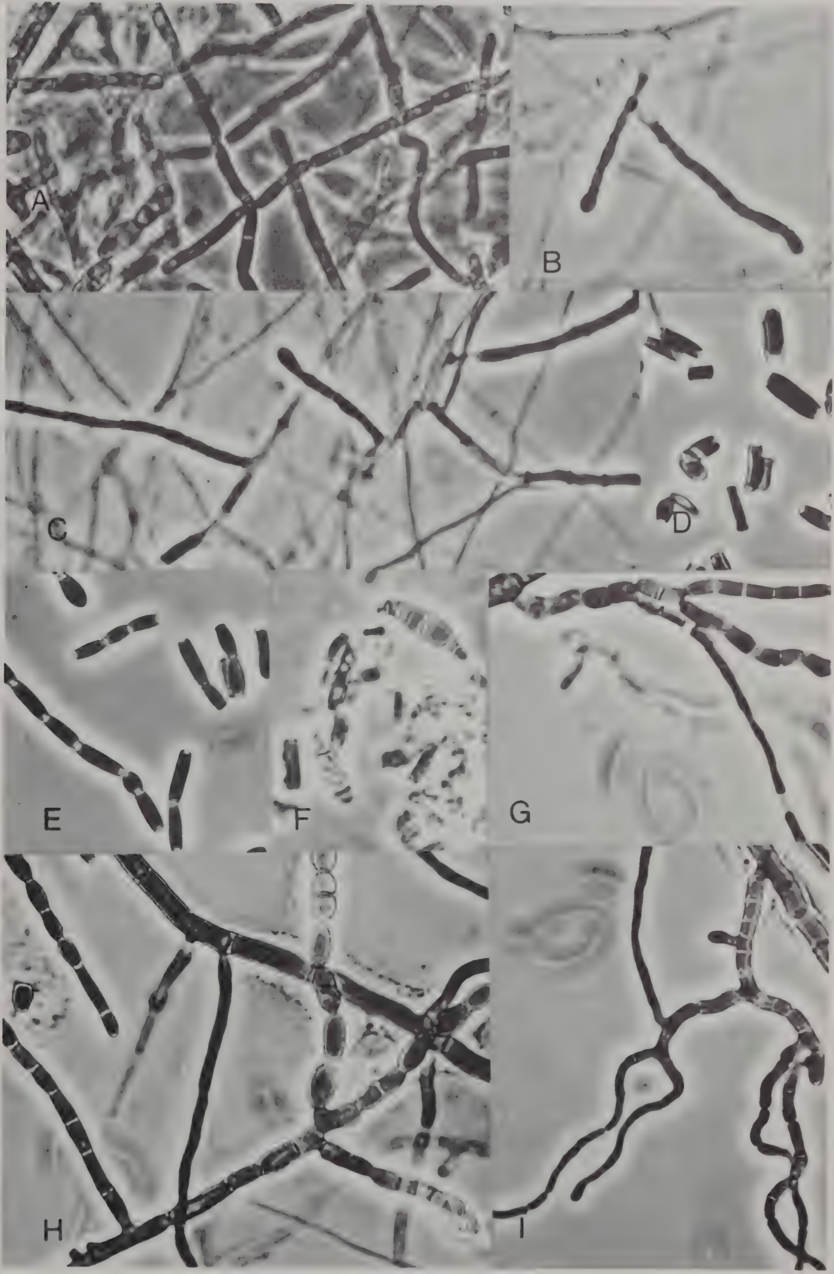
Figure 9. A. Scytalidium acidophilum (UAMH 3460). B-F. Scytalidium flavo-brunneum (B,C-3487; D,F-617). G-I. Scytalidium state of Hendersonula toruloidea (3770). Fig. 9A. Chains of thick-walled arthroconidia. Figs. 9B-9C. Fission arthroconidia forming on lateral branches. Figs. 9D-9E. Mature brown arthroconidia with hyaline apices. Fig. 9F. Multi-septate conidia. Figs. 9G-9I. Chains of arthroconidia forming on broad hyphae or narrower lateral branches. All x 600.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of drying, colonies (see Materials and Methods) are exposed overnight to a General Electric germicidal 15 w lamp, and when dried are placed in plastic bags for storage. However, the agar was not completely dry and the colony eventually formed pycnidia within the plastic bag. Subsequently, pycnidia developed on straw agar (chopped decomposing straw, 3%; agar 1.5%) after 49 days incubation at 25 C.

Habitat and activities: Reported from fruit trees of many types principally citrus and stone fruits (Nattrass, 1933; Wilson, 1947, 1949; Hughes, 1952; Calavan and Wallace, 1954) and Persian walnut, black walnut, European chestnut (Wilson, 1949; Calavan and Wallace, 1954). Cellulolytic. Moderately keratinolytic (Campbell, 1974; Evans and Hose, 1975).

Material examined: UAMH 3770, from fingernail of Jamaican-born resident of England, at Univ. of Birmingham, C.K. Campbell (M40)

Sporendonema Desmazieres 1827

History

In 1827 Desmazieres described and illustrated *Sporendonema casei* which he found growing on outer crusts of cheese. He noted the affinity of *S. casei* to *Mucor crustaceus* Bulliard, *Aegerita crustacea* De Candolle, and *Oidium rubens* Link and suggested that none of these authors had correctly interpreted the manner of spore formation. Desmazieres recognized two different forms of spore dissemination, one through release from the tip of the fertile hypha and the other by destruction of the outer hyphal wall. Disagreement among mycologists on the exact nature of spore formation and dehiscence has resulted in considerable confusion over the placement of this species. At our request, Mme. J. Nicot searched for type material of *S. casei* in the exsiccati of Desmazieres located at the Museum of Natural History, Paris, but was unable to find any.

S. casei was transferred to *Torula* Persoon as *T. casei* by Corda (1838) and later as *T. sporendonema* by Berkeley and Broome (1850). Berkeley and Broome disagreed with Desmazieres' interpretation of spore formation and noted "Corda's *Torula Casei* appears to be very different". Bonorden (1851) followed Fries (1832) in accepting Desmazieres' *Sporendonema casei* as the correct name for this fungus, and later Bainier (1907) reviewed *S. casei* and described two new species.

However, Saccardo in 1882 referred *Torula sporendonema* Berk. & Br. to *Oospora* Wallr., a nomen illegitimum, as *O.*

crustacea (Bulliard) [= Mucor crustaceus Bull.]. In 1886 Saccardo placed Sporendonema casei in synonymy with O. crustacea. Lindau (1907) accepted this transfer.

Sumstine (1913) complicated the taxonomy of this fungus by stating that O. crustacea was congeneric with Oospora lactis (Fres.) Saccardo (now Geotrichum candidum). Sumstine also considered Chalara mycoderma Bonorden, another species referred to G. candidum (Carmichael, 1957), as a possible synonym of S. casei.

Oudemans in 1886, according to Lindau (1907), emended Sporendonema to include a new species, S. terrestre, whose status is now uncertain. Arnaud (1952), in describing Nyctalina lignicola, stated that it resembled S. terrestre.

In classifying a fungus isolated from curing blue cheese, Hammer and Gilman (1944) outlined the problems in naming the fungus. After reviewing the literature, they recommended retention of the name Sporendonema casei agreeing with Desmazieres' original interpretation. In addition, the authors accurately and precisely recorded the conidium development of S. casei. More recently, von Arx (1970) also accepted Sporendonema casei Desmazieres.

Generic Description

Hyphae septate, broad, hyaline; conidiophores lacking. The fertile hyphae are branched, often dichotomously; at first sparingly then more regularly septate, with septa forming first near the apex of the hypha. Arthroconidia are formed by condensation of the cytoplasm in adjacent or more often alternate segments separated by one or more empty cells. Maturing arthroconidia, retained within the original outer hyphal wall, become thick-walled and are released by fracture or lysis of the intervening empty cell. Arthroconidia are hyaline or pink or yellow, mostly more than 4um broad, smooth, thick-walled.

Sporendonema is distinguished from Coremiella by its light colored hyphae and arthroconidia. Furthermore, Coremiella may develop coremia on natural substrates, though rarely in culture. Coremium formation has not been reported in Sporendonema. Malbranchea differs from Sporendonema in the width of the hyphae and arthroconidia, which in Malbranchea rarely exceeds 4um.

Type Species

Sporendonema casei Desmazieres 1827, Ann. Sci. Nat. XI:247; Desmazieres 1827, Rec. Trav. Soc. Sci. Agric. Arts, Lille p. 185-187, pl. 3
= Torula casei (Desm.) Corda 1838, Icon. Fung. 4:8, fig. 36
?= Mucor crustaceus Bulliard 1782, Bull. Champ. Tab. 100

= Oospora crustacea (Bull.) Saccardo 1882, Michelia 2:545
?= Aegerita crustacea DeCandolle 1805, Fl. France 2:72
= Torula sporendonema Berkeley & Broome 1850, Ann. Mag. Nat. Hist. ser. 2, 5:460
?= Oidium rubens Link 1815, in Mag. Ges. Naturf. Freunde, Berlin 7:37

If Desmazieres' assertion that Aegerita crustacea DeCandolle is the same species as S. casei can be corroborated then this earlier specific epithet would take precedence. Similarly, Link's brief description of Oidium rubens is difficult to interpret with certainty, but it may also be an earlier specific epithet for S. casei.

Description

S. casei is psychrophilic, growing and sporulating well at 8 C. Colonies grow slowly at 25 C with scant sporulation, and fail to grow at 30 C. At 18 C, colonies on PYE agar are 30 mm in diam., flat, downy, creamy white front and reverse. On cereal agar, growth is slower but more luxuriant, at first creamy white, then cinnamon yellow as sporulation commences. The reverse is pink and a pink pigment diffuses into the medium. In microscopic preparations numerous large dark brown rod-shaped crystals may be found.

Characteristically the fertile hyphae, arising as lateral branches from the vegetative mycelium, are slightly broader, mostly curved or loosely coiled, or straight (Figs. 10A,10B) and the cytoplasm is more dense. Septa, forming in more or less regular segments, are thick suggesting double septa (Fig. 10C). Concentration of cytoplasm occurs in alternate or adjacent segments (Fig. 10B) and the internally developing arthroconidia synthesize new wall material. Maturing arthroconidia often become rounded at the corners and the original outer hyphal wall remains visible. Mature arthroconidia (Fig. 10D), released by fracture, sometimes remaining connected in a chain of 2 or 3, are yellow or hyaline, oblong, smooth (3)4-5 x 4-8(10)um. In old cultures, cinnamon colored arthroconidia are released not only by fracture of the hypha, but also by extrusion from the apex of the outer hyphal tube (Figs. 10E,10F), leaving a section of empty hypha, exactly as described by Desmazieres (1827).

Habitat and activities: Reported mostly from cheese; other records should probably be referred to Scopulariopsis, according to Wakefield and Bisby (1941). Neither cellulolytic nor keratinolytic.

Material Examined

UAMH 1506, from cheese, England by Galloway, 1949, CMI

37084; UAMH 1508, from wooden cheese drum, London, England by Worthington, 1957, CMI 68748; UAMH 3790, isolated at Hokkaido Univ., Japan by Sasaki (AHU 9107), 1963, from Tubaki, IFO, Japan as 7656.

Sporendonema purpurascens (Bonorden) Mason & Hughes 1953
apud Wood 1957, Nature 179:328
≡ Coprotrichum purpurascens Bonorden 1851, Handbuch allgemeinen Mycologie p. 76, fig. 32 (Basionym)
≡ Geotrichum purpurascens (Bonorden) Saccardo 1886, Syll. Fung. 4:40
?= Geotrichum roseum Grove 1886, Syll. Fung. 4:40 fide Caretta 1959
≡ Allonema roseum (Grove) Sydow 1934, Ann. Mycol. 32:283
?= Sporendonema roseum Grove var. album Arnaud 1952, Bull. Soc. Mycol. France 68:192, fig. 3,C,D

History

In 1851, Bonorden described and illustrated Coprotrichum with two species, C. purpurascens and C. cinereum. The hyphae and spores of C. purpurascens were described as purple whereas those of C. cinereum were greyish. In 1886, Saccardo transferred both species to Geotrichum. Later, Windisch (1951) listed both species as synonyms of Endomyces lactis and subsequently Carmichael (1957), in emending Geotrichum, included all three as synonyms of G. candidum Link.

At about the same time, Wood (1957) in a brief report on a disease of cultivated mushrooms caused by a so-called 'red Geotrichum' or 'lipstick mold' cited Mason and Hughes' identification of the causal agent as Sporendonema purpurascens (Bonorden) [≡ Coprotrichum purpurascens]. According to Wood, the fungus Bonorden described as Coprotrichum purpurascens was not identifiable with G. candidum and should be removed from Geotrichum. Certainly Bonorden's description of the hyphae and spores as purple would indicate a difference from G. candidum. Although Sporendonema purpurascens is the name commonly applied to the fungus known as the 'lipstick mold' (Cole and Kendrick, 1969; von Arx, 1970; Kendrick, 1971, p. 164), Kendrick and Carmichael (1973), in a review of Hyphomycete genera, list Coprotrichum as a synonym of Geotrichum.

Caretta (1959), following Redaelli and Ciferri (1934) and Ciferri (1958) in accepting Oudemans' (1886, in Lindau 1907) emended description of Sporendonema Desmazieres, retained Coprotrichum purpurascens for the neotype culture of Wood (1957). However, Redaelli and Ciferri (1934) included in Sporendonema unrelated fungi (Dodge, 1935) and the fungus they called Sporendonema epizoum has been transferred to Wallemia as W. sebi (Fries) von Arx (1970) (see excluded species).

Caretta (1959) listed a number of synonyms for C. purpurascens including Monilia miniata Wallr. (?= S. casei, see Saccardo, 1886, p. 20), Oospora crustacea Sacc. [?= S. casei Desm.], Endoconidium luteolum Delacr., Oidium rubrum Proks., Scopulariopsis casei Loubiere, ? Oidium aurantiacum Henneberg, Coprotrichum crustaceum Cif. & Red. and Coprotrichum lutescens Cif. & Red. We have not seen the original descriptions of these species.

Description

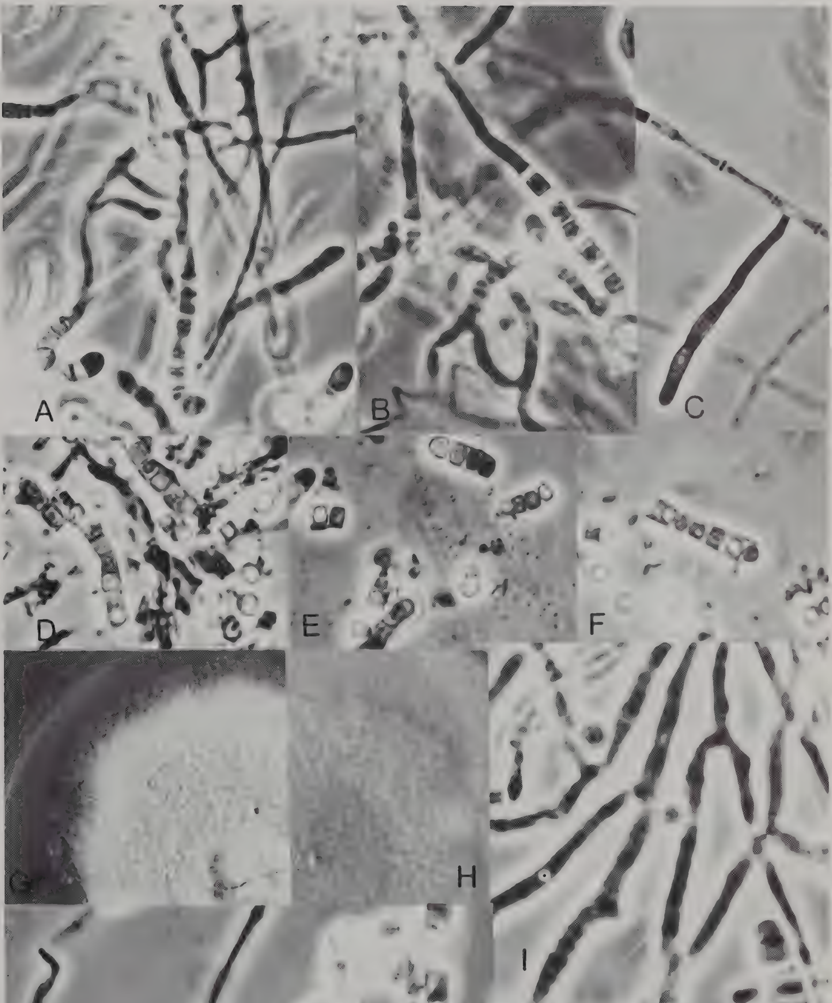
Colonies on PYE (Fig. 10G) are 55-68 mm in diam. in 21 days. Aerial growth at first scant, cottony, white, then rose-pink with white margin, dense, cottony or more often powdery, flat with central plateau, dry, cracked. The reverse is burnt orange in culture but burgundy when dried. Growth on cereal agar (Fig. 10H) is less luxuriant (45-60 mm diam. in 21 days), cottony, at first white then peach or pale pink, reverse white with tan or pink diffusing pigment. No growth at 37 C; optimum 25-30 C.

Alternate arthroconidia form on undifferentiated hyphae which may branch dichotomously (Fig. 10I). Arthroconidia (Figs. 10J,10K) are cylindrical or oblong, discoid in end view, hyaline at first, later pink, thick-walled, smooth, 4-7 x 4-12(15)um. The formation of arthroconidia has been recorded by time-lapse photography (Cole and Kendrick, 1969).

Habitat and activities: Commonly associated with cultivated mushrooms. S. purpurascens, one of several fungi tested by Komatsu (1969) inhibited Pholiota nameko in vitro at 25 C but failed to do so at 12 C. Weakly cellulolytic after prolonged growth, not keratinolytic.

Material Examined
From mushroom beds: UAMH 432 and 433, rec. from Kneebone, Penn. State Univ., as isolates A and B respectively; UAMH 1497, NEOTYPE, Chesham, England, F.C. Wood, 1951, CMI

Figure 10. A-F. Sporendonema casei (A,B,D-F-UAMH 3790; C-1506). G-K. Sporendonema purpurascens (G-I,K-432; J-3791). Figs. 10A-10C. Alternate arthroconidia developing on straight or curved fertile hyphae. Fig. 10D. Mature arthroconidia. Figs. 10E-10F. Extrusion of arthroconidia from the apex of the outer hyphal wall. Figs. 10G-10H. Colonial morphology after 21 days at 25 C. G on PYE, H on cereal. Fig. 10I. Dichotomously branched fertile hyphae. Fig. 10J-10K. Alternate arthroconidia. Colonies x 0.7, others x 600.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45638; UAMH 3791, same strain as UAMH 1497, rec. from Tubaki, IFO as 7659 (ex CMI 45638).

Species of Uncertain Status

Sporendonema salicis Bainier 1907, Bull. Soc. Mycol. France 23:24, pl. VI, fig. 7-9; Saccardo and Trotter 1913, Syll. Fung. 22:1240

No authentic material of *S. salicis* could be located (Nicot, pers. comm.).

Sporendonema artemisiae Bainier 1907, ibid, pl. VI, fig. 10-12; Saccardo and Trotter 1913, Syll. Fung. 22:1240

Bainier reported this species on dead stems of the mugwort, *Artemisia*, forming well developed yellowish-white or grey tufts (coremia?). It could be *Coremiella cubispora* (Berk. & Curt.) Ellis. Bainier lists the size of the conidia as "1um12 - 1um25" and Saccardo and Trotter interpret these measurements as "1,12 - 1,25" u. However, according to the illustrations (all at the same magnification), the diameter of the conidia of *Sporendonema artemisiae* exceeds that of *S. salicis* which was given by Bainier as "4um2". These measurements of Bainier appear to be in error. No authentic material of *S. artemisiae* could be located (Nicot, pers. comm.).

Sporendonema terrestre Oudemans 1886, Versl. en. Med. Konink. Ak. Wetensch. Amsterdam Afd. Natuurk. 3, ser. 2:115, pl. 1

The description and drawing in Lindau (1907, pp. 22-23) vaguely suggest *Scytalidium flavo-brunneum*, but no one since Oudemans seems to have examined the type.

Sporendonema roseum v. *album* Arnaud 1952, Bull. Soc. Mycol. France 68:192, fig. 3,C,D

Perhaps *Sporendonema purpurascens*, but there is no specimen preserved with Arnaud's material (Nicot and Charpentie, 1971).

Excluded Species

Sporendonema sebi Fries 1849 = *Wallemia sebi* (Fr.) von Arx 1970

Sporendonema epizoum (Corda) Ciferri and Redaelli 1934 = *Wallemia sebi* fide von Arx 1972

PART II MALBRANCHEA SACCARDO 1882

Type Species

Malbranchea pulchella Saccardo & Penzig 1882, Michelia 2:638

History

In 1882 Saccardo established the form-genus Malbranchea for a single species, M. pulchella Saccardo and Penzig, found growing on damp cardboard in Rouen, France. Although providing no illustrations, Saccardo described the characteristic branched, arcuate, or curved fertile hyphae. In reporting the extrusion of conidia from the apex of the fertile hyphal branch, "ex apice ramulorum continuo exsilientibus", he failed to recognize the arthric nature of conidium dehiscence. Later repeating his original description, he (1886) referred to the affinity of Malbranchea with Oospora Wallroth and Glycophila Mont. He did not describe the cultural characteristics of the organism.

Since its original description, Malbranchea has been largely ignored by mycologists. Two other species, M. bolognesii-chiurcoi Vuill., Poll. & Nann. and M. kambayashii Kamb., were described in the period 1925-1935, but later reduced to synonymy with M. pulchella. Miehe (1907) described in detail, Thermoideum sulfureum, a thermophilic fungus, but Saccardo (1908) and Saccardo and Trotter (1913) considered it a synonym of M. pulchella. More recently, attention focused on thermophilic isolates of Malbranchea, when Cooney and Emerson (1964) reviewed the history of the genus and provided an excellent description. The history of the mesophilic and thermophilic species are discussed under M. pulchella and M. sulfurea (Miehe) Sigler & Carmichael respectively.

Generic Description

Hyphae hyaline, septate; conidiophores absent. Primary hyphae straight, branched, mostly the same diameter, or slightly broader than the fertile hyphae, rarely exceeding 4um in diameter. Fertile hyphae, arising as branches from the primary hyphae, characteristically arcuate, in some species straight, branched, narrow, 1.5-3um, rarely exceeding 4um in width. Hyphae at first sparingly septate, then regularly so, with concentration of cytoplasm in alternate segments, separated by 1 or more empty cells; arthroconidia released by lysis or fracture of outer hyphal walls of intervening empty cells. Alternate arthroconidia smooth-walled, cylindrical-truncate, curved or straight, hyaline, later becoming yellow, tan, orange, or greenish-yellow, not wider in diameter than the hypha which bears them.

In brief, the form-genus *Malbranchea* is characterized by regular, narrow, alternate arthroconidia. It resembles *Coremiella* and *Sporendonema*, but both of the latter have wider hyphae and arthroconidia. In addition, *Coremiella* is dematiaceous. *Ovadendron* differs from *Malbranchea* in having swollen arthroconidia.

Comments on the Key and Descriptions

Species of *Malbranchea* can be divided into two groups: those having arcuate or curved fertile hyphae and those having more or less straight fertile hyphae. In the descriptions of the species, the ones with arcuate fertile hyphae are given in alphabetic order in Part A, and the ones with straight fertile hyphae in Part B. In some species, arthroconidia may also form in the wider, straight primary hayphae. These are referred to in the key as accessory conidia. The size range of arthroconidia varies little among the species of *Malbranchea*. For this reason, the colonial morphology and color are important characters in distinguishing among the species. For color photographs of colonies, see Fig. 22.

KEY TO THE SPECIES OF *Malbranchea*

Conidiophores absent 1
Conidiophores hyaline .... Try *Geomyces*
Conidiophores pigmented ....Try *Oidiodendron*
1. Fertile hyphae mostly more than 4um wide ....Try *Sporendonema*
1. Fertile hyphae mostly narrower 2
2. Fertile hyphae arcuate or curved (Part A) 3
2. Fertile hyphae straight, branched (Part B) 11
3. Fertile hyphae tightly coiled, accessory conidia lacking 4
3. Fertile hyphae curved, arcuate, accessory conidia present 6
4. Colonies thermophilic; conidia 2.5-4.5um wide ....*M. sulfurea*
4. Colonies not thermophilic; conidia mostly narrower .. 5
5. Colonies dark gold; sexual state *Myxotrichum* ....*M. circinata*
5. Colonies tan, white or pale brown .... *M. pulchella*
6. Colonies orange 7
6. Colonies pale colored 9
7. Homothallic; sexual state *Auxarthron* ....*A. conjugatum*
7. Not homothallic; sexual state absent 8
8. Arthroconidia intergrade with aleurioconidia formed laterally or terminally ....*M. chrysosporoidea*
8. Aleurioconidia absent .... *M. aurantiaca*
9. Colonies restricted, pinkish-buff; sexual state *Myxotrichum* .... *M. flavorosea*
9. Colonies some other color 10
10. Colonies ivory yellow, spreading, zonate; *Auxarthron*

SEE ERRATA

sexual state ....*M. albolutea*

10. Colonies buff or tan, rarely white, restricted or spreading ....*M. arcuata*

11. Branching of fertile hyphae regularly acute, arborescent ....*M. dendritica*

11. Branching of fertile hyphae otherwise 12

12. Arthroconidia mostly narrow, 1.5-3um 13

12. Arthroconidia mostly broader, 2.5-5um 17

13. Fertile hyphae, repeatedly branched, in dense tufts ....*M. flocciformis*

13. Branching of fertile hyphae more restricted 14

14. Colonies buff, tan or white 15

14. Colonies lemon-yellow .... *M. flava*

15. Colonies white, restricted .... *M. gypsea*

15. Colonies buff or tan 16

16. Arthroconidia with refractile terminal walls, mostly 2-3 x 3.5-8(11)um ....*M. fulva*

16. Arthroconidia broader, 2.5-3.5 x 3.5-6um; uncinate appendages mostly present .... *Uncinocarpus reesii*

17. Arthroconidia broad, 3-5um, closely spaced .... *M.* state of *Coccidioides immitis*

17. Arthroconidia narrower, 2.5-3.5um, irregularly spaced; uncinate appendages mostly present *Uncinocarpus reesii*

Perfect States

The perfect states of *Malbranchea*, where known, belong in the Gmnoascaceae (Kuehn, Orr and Ghosh, 1964; Hubalek, 1974a). This family of the Eurotiales is also reported to have conidial states in the form-genera *Trichophyton* and *Microsporum* (Rebell and Taplin, 1970), *Chrysosporium* (Carmichael, 1962; Apinis, 1970; Varsavsky and Orr, 1971; von Arx, 1971; Samson, 1972; Orr and Kuehn, 1972; Fennell, 1973), *Oidiodendron* (Orr and Kuehn, 1964a; Barron and Booth, 1966; Morrall, 1968; Muller and Pacha-Aue, 1968; von Arx, 1971; Fennell, 1973; Tokumasu, 1973), and *Geotrichum* (von Arx, 1971).

A closely related family, the Onygenaceae, is also known to have arthroconidial and aleurioconidial states (Tubaki, 1960; Malloch and Cain, 1971; Samson and van der Aa, 1973; Fennell, 1973). The lack of a phialoconidial state distinguishes the Gymnoascaceae from the Eurotiaceae (Stolk and Samson, 1972; Fennell, 1973).

Arthroconidial states have been described for a number of species of Gymnoascaceae, although they have been frequently referred to in earlier reports as 'oidia', or chlamydospores, or arthrospores (Kuehn, 1955b, 1959; Benjamin, 1956; Apinis, 1964). Orr *et al.* (1963b) introduced the term 'arthroaleuriospore' or 'arthroaleurie' to differentiate alternate arthroconidia from the 'true', i.e., fission arthroconidia of Geotrichum. However, Orr et al. (1963a,b) considered the arthroaleuries to be variable and therefore of little value in distinguishing among species.

Some Malbranchea species described here were found to have sexual states in Myxotrichum, Auxarthron and Uncinocarpus. For the species we have described, the Malbranchea state is the one usually produced in culture, and thus would be used for identification. It should be noted that there are a number of homothallic Gymnoascaceae, not described here, which produce a Malbranchea state in culture along with the gymnothecia. Since the perfect state would normally be used for identification, and since we have not made a thorough study of this group, these species are not described or included in the key.

Gymnothecium production in the Gymnoascaceae is stimulated by growth on oatmeal-salts agar (Weitzman and Silva-Hutner, 1967; Padhye et al., 1973) and by incubation at different temperatures such as 18 C, 25 C and 30 C. Strains failing to form gymnothecia at 25 C may do so readily at 18 C or 30 C, although the lower temperature more often stimulates development. In addition, keratinophilic isolates form gymnothecia when grown on dextrose-salts agar, a minimal nutrient medium, sprinkled with a keratinous substrate such as hair. Gymnothecium production is enhanced in cellulolytic fungi by growth on a cellophane membrane on the surface of the agar (see Materials and Methods) although the membrane tends to limit gymnothecium formation in keratinophilic isolates. Some, especially degenerate strains or ones maintained for long periods in culture, require an additional stimulus, usually prolonged growth, 6-10 weeks or more, or multiple transfers on oatmeal-salts agar.

Ecology and Distribution

Malbranchea is a common soil fungus having a worldwide distribution. Species are mesophilic, thermotolerant or thermophilic and may be keratinolytic or cellulolytic.

Thermophilic isolates of Malbranchea sulfurea are cellulolytic, and commonly associated with self-heating decomposing matter, or dung. Since its description by Cooney and Emerson (1964), this species has been frequently reported (see M. sulfurea).

However, other records of Malbranchea are rare. Few reports of Malbranchea have occurred in surveys of keratinophilic fungi (Rebell and Taplin, 1970; Orr and Kuehn, 1972; Hubalek, 1974a; Hubalek and Balat, 1974; Rippon, 1974; Ajello and Padhye, 1974). Malbranchea is a little known genus, and isolates may well have been listed as unidentified *Chrysosporium* species or more probably as unidentified Gymnoascaceae or as asexual states of Gymnoascaceae (Emmons, 1954; Rees, 1967a,b; De Vroey, 1970; Hubalek, 1974a; Caretta and Piontelli, 1975). A number of species of *Malbranchea* have their sexual states in the Gymnoascaceae. Some keratinolytic thermotolerant species are asexual states of *Auxarthron* whereas some mesophilic cellulolytic species are asexual states of *Myxotrichum*.

With the exception of the *Malbranchea* state of *Coccidioides immitis*, a human pathogen, there is little evidence to suggest that species of *Malbranchea* are pathogenic. However, arthroconidia of nonpathogenic species may be transient inhabitants of man and animals, recoverable from tissues of animals such as rodents, and surviving passage through animals (Emmons, 1954; Kuehn *et al*., 1964; Orr, 1968; Rippon, 1974). Some species of *Malbranchea* have been previously reported as fungi which resemble *C. immitis* (Emmons, 1954, 1967; Plunkett, Walker and Huppert, 1963; Huppert, Sun and Bailey, 1967; Orr, 1968; Orr and Kuehn, 1972).

Temperature relationships and activity of isolates are important in differentiating species of *Malbranchea*. Incubation at 18 C or 30 C often stimulates formation of the sexual state. Since arthroconidium morphology in many species of *Malbranchea* is rather uniform, colony appearance becomes an important character. The morphology and growth rate of colonies at different temperatures are valuable taxonomic characters for differentiation among species.

A) Malbranchea species with arcuate fertile hyphae

Malbranchea albolutea Sigler & Carmichael sp. nov.

Sexual state: Auxarthron Orr, Kuehn & Plunkett 1963a

Coloniae in agaro ad 25-30 C rapide crescunt, alboluteae, pulveraceae, rimosae. Incrementum nullum ad 37 C. Arthroconidia cylindrica, aliquando curva, laevia, hyalina vel flava, 1.5-2 x (2.5)3-5(6)um. Arthroconidia ex hyphis principalibus crassiora, aliquando inflata, 2.5-3(4) x (1.5)2-5(6.5)um.
Status perfectus: Auxarthron, sed species incerta est.
Typus: UAMH 2846, ex solo, Utah, 1967, G.F. Orr, O-3508

Colonies on PYE (Fig. 11A) at 25-30 C (optimum range) are 50-57 mm diam. in 21 days, pale ivory-yellow, reverse yellow, powdery, dry and cracked. The surface is slightly raised with central umbo, two or three powdery zones and downy periphery. The periphery develops broad, flat sectors, having scant aerial growth, identical to the margin. The zonate pattern and sectoring is less evident on downy colonies. On cereal, colonies (Fig. 11B) are 42-53 mm diam. in 21 days, pale ivory-yellow or creamy buff, reverse yellow, powdery, dry, cracked by numerous tiny fissures, periphery downy, rarely sectoring. The surface is flat, with tiny central umbo or zone of scant aerial growth at center. No growth at 37 C except scant growth by UAMH 1846.

Arthroconidia, borne on narrow, arcuate or curved lateral branches (Figs. 11C,11D), are cylindrical sometimes curved, hyaline, in age yellow, 1.5-2 x (2.5)3-5(6)um. Arthroconidia formed by segmentation of the broader primary hyphae (Fig. 11D) are hyaline, cylindrical, 2.5-3(4) x (1.5)2-5(6.5)um. In age, racket hyphae, and enlarged, subglobose, or irregularly shaped arthroconidia (Fig. 11E) are

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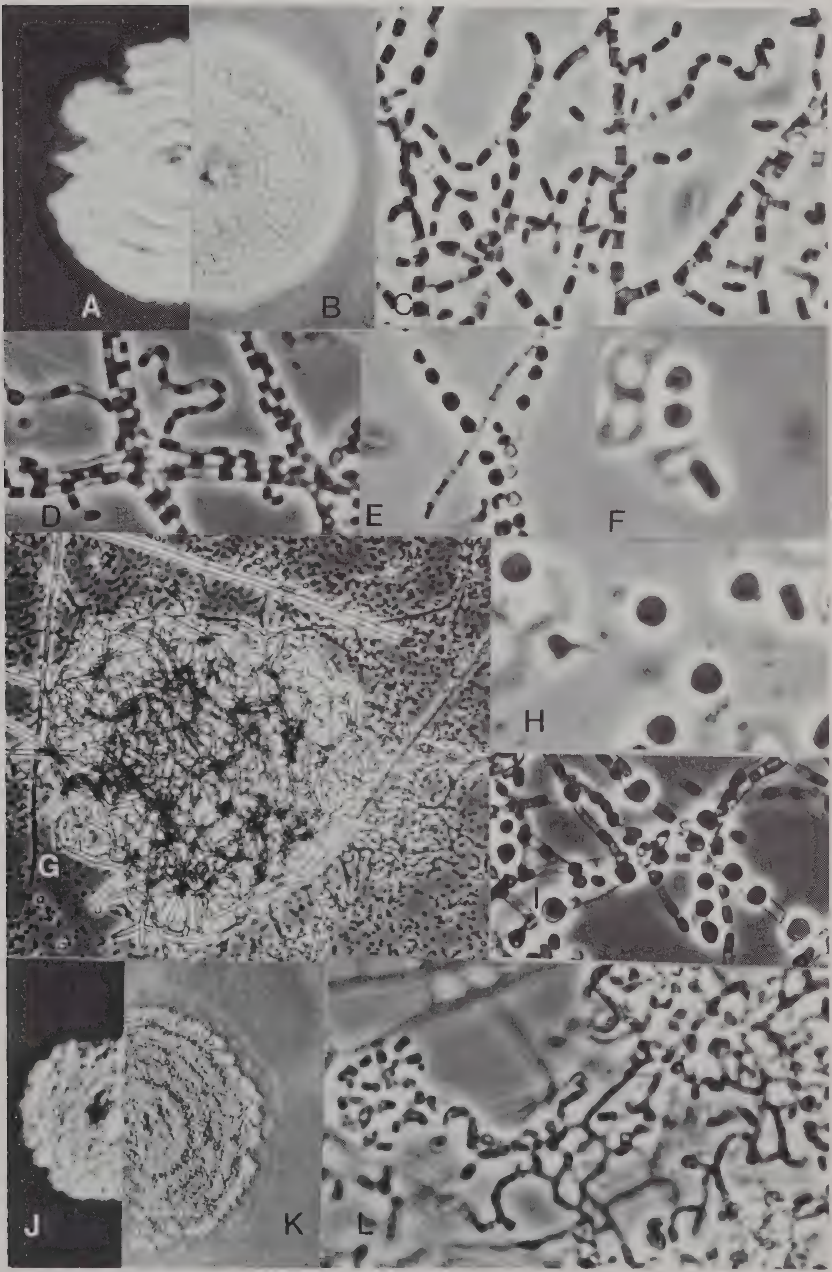
Figure 11. A-H. Malbranchea albolutea (A,B,F,G-UAMH 2846; C-1846; D-2861; E-2848; H-3651). I-L. Malbranchea arcuata (I-1861; J-L-2519). Figs. 11A. Colonial morphology after 21 days at 25 C, x 0.7. A on PYE, B on cereal. Figs. 11C-11D. Alternate arthroconidia of arcuate branches and straight primary hyphae, x 600. Fig. 11E. Chains of enlarged arthroconidia, x 600. Fig. 11F. Globose ascospores, x 1680. Fig. 11G. Gymnothecium with elongate appendages, x 150. Fig. 11H. Finely asperulate ascospores, x 1680. Fig. 11I. Chains of enlarged arthroconidia, x 600. Figs. 11J-11K. Colonial morphology after 21 days at 25 C, x 0.7. J on PYE, K on cereal. Fig. 11L. Alternate arthroconidia borne on arcuate branches, x 600.


A
B
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formed.

Gymnothecia (Fig. 11G) are spherical, discrete, 280-400um in diameter (excluding elongate appendages), brown, composed of a branched network of thick-walled, delicately asperulate, septate, 3-5um wide, yellow-brown hyphae, with free apices terminating in bluntly pointed spines. Elongate appendages (Fig. 11G) arising from a bifurcate base are 400-800um long, smooth, thick-walled and yellow-brown over half the length, tapering to a hyaline apex, straight, rarely uncinate. The hyaline portion is often broken off, leaving the tip blunt. Asci are evanescent, hyaline, 6.5-8um in diameter, 8-spored. Ascospores (Figs. 11F,11H) are globose, delicately roughened, yellow (2.2)2.5-3.5um. The ascospores appear smooth at low magnification and the rough surface is often difficult to detect even at high magnification (x2700)(Figs. 11F,11H).

Discussion

Malbranchea albolutea differs from other Malbranchea species having arcuate fertile hyphae, such as M. aurantiaca and M. arcuata, in its creamy white to pale ivory-yellow colored colonies. Moreover, it forms a sexual state in culture.

Most isolates developed gymnothecia only after prolonged growth on oatmeal agar without cellophane. Even when gymnothecia are produced, the colony remains creamy white in color, never orange or brown. The gymnothecia mature slowly, requiring 6-8 weeks or longer before ascospores are produced. In some strains, even apparently mature gymnothecia often contain no ascospores. However, ascospores can be induced by repeated transfers on oatmeal agar and growth at 25 C or 30 C.

The sexual state of M. albolutea is assigned to Auxarthron, a genus distinguished from other genera of the Gymnoascaceae by its net-like anastomosed peridial hyphae bearing prominent enlarged septa, described as 'knuckle-joints', and by its ascospore morphology (Orr et al., 1963a). These generic characters have not been accepted by some others. Apinis (1964) noted that enlarged septa also occurred in some species of Gymnoascus and in Myxotrichum herbariense [= Tripedotrichum herbariensis Orr & Kuehn, 1964b]. Therefore, he retained Auxarthron and Pseudogymnoascus Raillo as subgenera of Gymnoascus. He included in the subgenus Auxarthron, species having uncinate or straight, elongate peridial appendages. Udagawa (1966) followed Apinis in retaining Gymnoascus.

Historically, the character of the peridial hyphae and appendages has received emphasis in classification of genera of the Gymnoascaceae. However, Samson (1972) in a study of Pseudogymnoascus, Gymnoascus and Auxarthron pointed to the variability of these characters during different stages and cultural conditions of growth, and suggested that more reliable characters for differentiation were morphology of the ascomatal initials, asci and ascospores. Samson (1972) retained all three genera and distinguished Auxarthron from Gymnoascus and Pseudogymnoascus on the basis of its globose or subglobose, roughened or echinulate ascospores and arthroconidial or aleurioconidial asexual state.

Eight species have been described in Auxarthron (Orr et al., 1963a; Orr and Kuehn, 1971, 1972). Samson (1972) suggested that a review of the number of species of Auxarthron should be considered. Species of Auxarthron, which have a rather uniform ascospore size and morphology, are difficult to differentiate by the morphology of the peridial hyphae and their appendages.

The sexual state of M. albolutea most closely resembles Auxarthron thaxteri (Kuehn) Orr & Kuehn [= Myxotrichum thaxteri Kuehn, 1955b]. Orr et al. (1963a) described Auxarthron brunneum based on Rostrup's description of Myxotrichum brunneum and placed M. thaxteri Kuehn in synonymy. Apinis (1964) compared Rostrup's type specimen of M. brunneum with the type material of Gymnoascus umbrinus Boudier and found the two to be identical. Apinis placed M. brunneum in synonymy with G. umbrinus v. umbrinus and retained Kuehn's M. thaxteri as a variety, G. umbrinus var thaxteri. After evaluating the type materials of Rostrup and Boudier, Orr and Kuehn (1971) disagreed with Apinis' (1964) placement of M. thaxteri and they proposed to retain it as a separate species, Auxarthron thaxteri. Myxotrichum brunneum Rostrup was placed in synonymy with A. umbrinum (Boudier) Orr & Plunkett, but Auxarthron brunneum sensu Orr & Kuehn (1963a) was placed in synonymy with A. thaxteri since the description of this species was based on the type culture of M. thaxteri.

The sexual state of M. albolutea appears to fit the description of Orr et al. (1963a) of A. thaxteri [= A. brunneum sensu Orr & Kuehn]. Indeed, the sexual state of one of the strains examined by them (0-1024, UAMH 1117) is identical with that described here. However, our examination of the type strain of A. thaxteri (UAMH 3912, NRRL 1714, ATCC 15598, 0-532) revealed that ascospores are ovoid, delicately roughened, 2-2.2 x 2.8-3.2um, compared to the ascospores of M. albolutea which are globose, delicately roughened (2.2) 2.5-3um in diameter. Secondly, the gymnothecia of both are similar in size and shape but the elongate appendages of A. thaxteri are shorter, 300-400um in length, and mostly uncinate. Finally, the arthroconidial state, M. albolutea, is prominent in early stages of growth, permitting recognition of this species, whereas the *Malbranchea* state of *A. thaxteri* is associated with the appearance of ascomatal initials in culture.

At present, the primary reason for not including the sexual state of *M. albolutea* in *A. thaxteri* is the difference in size and shape of the ascospores. Obviously, this difference in size is small and would normally be part of the range of variation for this species, but the shape of ascospores within a species should be uniform. Indeed, the ascospores of all isolates of *M. albolutea* are uniformly globose. The ascospores of *Auxarthron* species are not only globose or subglobose as suggested by Samson (1972) but also oblate and may be delicately roughened to spiny or echinulate-reticulate. For the present, the sexual state of *M. albolutea* has not been assigned to *A. thaxteri* nor has it been described as a new species, because the already named species of *Auxarthron* need reevaluation before additional ones are added.

Habitat and activities: Recovered from soil or dung, in the USA, from Utah, Colorado, California and Wyoming and in Hungary. Moderately keratinolytic, no penetrating bodies; not cellulolytic.

Material Examined
From soil: UAMH 1117, Oildale, Calif., (Orr 0-1024); UAMH 2632, soil?, Cache la Poudre River, Col., W.B. Cooke, 1965, from Barron, Ont. Agric. College as 10527; UAMH 2846, TYPE, Utah, G.F. Orr, 1967, (0-3508); UAMH 2848, fabric bait technique, Hungary, G.F. Orr, 1967, (0-3515); UAMH 2861, Utah, G.F. Orr, 1967, (0-3509); UAMH 3651, Wendover, Utah, (Orr PO-0062); UAMH 3911, grasslands, Laramie, Wy., M. Christensen (TC-22), (Orr 0-1030); From dung: UAMH 1846, rat, Mercur, Utah, (Orr 'Merc'; ?0-1089); Material of *Auxarthron thaxteri*: UAMH 3912, TYPE, dung of opossum shrew (*Selenodon*), Haiti, R. Thaxter, (Orr 0-532; NRRL 1714; ATCC 15598)

Malbranchea arcuata Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25-30 C moderatim vel lente crescunt, alutaceae, pulveraceae, rimosae, aliquando plicatae. Incrementum nullum vel paulum ad 37 C.
Arthroconidia cylindrica, frequenter curva, laevia, hyalina vel alutacea, (1.5)2-3 x 3-6um, in senectute aliquando amplificata, subglobosa vel irregularia.
Typus: UAMH 1861, ex solo, Utah, G.F. Orr, 0-1094 (DPG 105)

Colonies on PYE (Fig. 11J) are 13-30 mm diam. in 14 days) slightly raised with small central umbo, or smoother with few folds. The center is tan, powdery, dry and cracked and the margin downy, creamy white and flatter, reverse yellow or yellowish tan. Colonies of some strains, growing more rapidly (45 mm in 14 days) are flatter, downy, creamy-white with pale tan center, reverse yellow, smooth or with few outward radiating folds. Growth at 37 C is variable. Of five strains tested, four (UAMH 1861, 2519, 2570 and 3910) failed to grow, but the other (UAMH 2983) showed scant growth. On cereal, colonies (Fig. 11K) are 23-40 mm diam. in 14 days, tan, reverse buff, flat, powdery, either slightly zonate, or patchy. Scant brown pigment diffuses into the medium on cereal and oatmeal.

Arthroconidia borne on narrow arcuate or curved lateral branches (Fig. 11L), are cylindrical, often curved, smooth, hyaline at first, later tan, (1.5) 2-3 x 3-6um. Arthroconidia, formed by segmentation of the straight primary hyphae are hyaline, cylindrical, slightly broader, mostly 3um wide, and predominate in young cultures. In age, some arthroconidia become enlarged, subglobose or irregularly shaped (Fig. 11I). No other spore state was observed.

Discussion

The tan powdery colonies and arthroconidia borne on arcuate hyphae are characteristic of _M_. _arcuata_. Some variation in colonial morphology and growth rates is evident among strains included in this species. However, there appears to be little justification for removing any to separate species since the microscopic morphology is uniform.

_M_. _arcuata_ is distinguished from other _Malbranchea_ species having buff or tan colored colonies, such as the _Malbranchea_ state of _Uncinocarpus_ _reesii_ and _Malbranchea_ _fulva_, by its arcuate hyphae. _M_. _aurantiaca_ and _M_. _albolutea_ differ in having orange, and pale ivory-yellow colonies respectively.

Habitat and activities: Recorded from soil, dung of dog and birds, hair of rodents, USA and Yugoslavia (Hubalek, 1974a,b). Scarcely to moderately keratinolytic, no penetrating bodies; not cellulolytic.

Material Examined
From soil: UAMH 1861, TYPE, Dugway, Utah, G.F. Orr (DPG 105; O-1094); UAMH 2519, Austin, Texas, C.J. Alexopoulas, 1965, (Orr as Alex(50); UAMH 3877, ?dog dung, C.J. Alexopoulas (50), (Orr O-3263); ?UAMH 2570, plant debris, from Columbia, S. Am., A. Rostrepo, from Emmons, Dept. Health, Bethesda, Md., as B 27-40; From pellets of _Merops_ _apiaster_ in nest, Pesirevo, Yug., Z. Hubalek, 1968: UAMH 3844, as 232B; ?UAMH 3845, as 236A; From hair of small rodents, Yug., Z. Hubalek, 1968: UAMH 3847, as JU 1623 2;

UAMH 3902, Apodemos sp. (BH 14), (Orr 0-3411); From other sources: UAMH 3842, feathers of Corvus monedula, Furka, Yug., Z. Hubalek, 1968, as 153A; UAMH 2983, from R.S. Pore, W. Virginia Univ. Medical Center, Morgantown as 704; UAMH 3910, from Ellis, NRRL 6089.

Malbranchea aurantiaca Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25-30 C moderatim rapide crescunt, frequenter cum zonis spiralibus vel concentricis, centraliter atro-aureae, aurantiae vel aurantio-brunneae, in peripheria cremeae. Incrementum bonum ad 37 C, nullum ad 45 C.
Arthroconidia cylindrica, frequenter curva, laevia, initio hyalina, dein aurantia vel fulva, 1.5-2 x (2) 3-5.5(6) um.
Arthroconidia ex hyphis principalibus crassiora, 3-4 x (2) 3-7 (7.5) um.
Status perfectus: probaliter Auxarthron, sed species incerta est. Ascosporae semel visae sunt.
Typus: UAMH 3599, ex aere laboratorii? (cultura contaminata), Utah, G.F. Orr, 0-1526

Colonies on PYE are 64-70 mm diam. in 21 days, spirally zonate (Fig. 12A), at center umbonate, dark yellow-gold or orange-brown, velvety or powdery; outer zones varying from dark gold or yellow-orange to creamy white and floccose at the periphery, reverse dark orange. The margin gradually extends in a spiral pattern around the colony, at first white with scant aerial growth eventually creamy white, floccose and dense. Sometimes the zonate pattern is not as distinct but the characteristic color remains. At 37 C growth on PYE (Fig. 12C) is almost as rapid (44-62 mm, rarely up to 72 mm in 21 days), flat with irregular folds, pale orange or tan, dark orange reverse, downy with droplets of yellow or brown exudate. No growth at 45 C; optimum range 25-30 C.

On cereal, colonies (Fig. 12B) are 53-62 mm diam. in 21 days, at first, domed, floccose and white; as sporulation commences, becoming flattened, dark yellow-gold, orange-brown or tan, powdery or granular, and sharply demarcated from a floccose, creamy white, raised peripheral ridge (Fig. 12B). Two gradations can occur around the center with an inner region, pale tan or creamy white and floccose, slightly raised above the flat center. The reverse is yellow and yellow pigment occasionally diffuses into the agar. At 37 C, the colony (Fig. 12D) is characteristically slower growing (42-56 mm in 21 days) flat, dark tan or brown, powdery or granular, dense or patchy, with orange surface growth forming a distinct orange glabrous margin, 5-8 mm wide, and light or dark orange reverse.

Arthroconidia borne on narrow arcuate or curved lateral branches (Figs. 12E,12F) are cylindrical, often curved (Fig. 12H) hyaline, later orange or tan in mass, smooth, 1.5-2 x (2)3-5.5(6)um. Arthroconidia formed on the straight primary hyphae (Fig. 12G) are hyaline, broader, cylindrical, 3-4 x (2)3-7(7.5)um and predominate in young cultures. The development of racket hyphae is common in the primary hyphae with swelling at the septum up to 9um in diameter. Rarely, intercalary chlamydospores are seen.

a) Atypical strains (UAMH 1569, 1853, 1709, 2844)

Four strains differ in several characters from those summarized in the description above. All four are indistinguishable microscopically (Figs. 12I,12J) from *M. aurantiaca* and they are retained here until similar isolates are found which show the differences to be constant.

Two strains (UAMH 1569 and 1853) are identical to each other, and differ from typical strains in having paler yellow-orange colonies, and in lacking the distinct spiral zonate pattern. At 37 C growth is more restricted (22-33 mm on PYE and 7-14 mm on cereal in 21 days.

UAMH 2844 is similar to strains UAMH 1569 and 1853 in the color of its colonies. On PYE the colony is smooth, not zonate, domed with a central umbo; on cereal, it is almost flat with sparse aerial growth at periphery and denser, raised center. This strain differs from all others in growing more robustly and rapidly at 37 C (75 mm on PYE and 63 mm on cereal in 21 days).

Strain 1709 differs in having slower growing (46 mm on PYE and 42 mm on cereal after 21 days), dark orange, velvety or downy colonies. On cereal, the colony is zonate with a central umbo and on PYE it is flat with broad white margin and central orange umbo. There is no growth at 37 C after 21 days. The arthroconidia are slighter broader, 2-3um in diameter. Late in the study we received another isolate (UAMH 3878) which greatly resembled UAMH 1709. These two strains may eventually require transfer to a separate species, but it seems preferable to retain them here until a larger number of isolates has been studied.

Discussion

The orange colonies of *M. aurantiaca* resemble those of the *M.* state of *Auxarthron conjugatum*. However, *A. conjugatum* is homothallic and regularly forms the sexual state in culture. Furthermore, the *M.* state of *A. conjugatum* lacks the spiral zonate pattern on PYE, and growth at 37 C is much more restricted. *M. chrysosporoidea* also forms orange colonies but lacks arcuate fertile hyphae. The color of the colony distinguishes *M.*

aurantiaca from M. arcuata and M. albolutea.

Habitat and activities: Isolated from soil or dung, India, Central America, Australia, USA and Belgium. Moderately or markedly keratinolytic, not cellulolytic.

Mating tests: Crosses were performed in duplicate by preparing mixed conidial suspensions (method A) and by parallel inoculation of separate conidial suspensions (method B) (see Materials and Methods), with the addition of autoclaved human hair.

With a single exception, no gymnothecia were seen in any cross after 42 days (Table II). In the mixed conidial suspension of UAMH 1707 x 3705, a single gymnothecium of the '*Auxarthron*' type (Orr, 1963a) bearing elongate uncinate appendages and few spiny oblate ascospores was seen. After a further two weeks growth no other gymnothecia were found nor were any discovered on the parallel streak plate. Incompatibility between strains was frequently indicated by a narrow or wide zone of inhibition between strains inoculated in parallel (Fig. 12K, Table II).

Failure to obtain the sexual state in this species was surprising considering the close resemblance to some species of *Auxarthron*, especially *A. conjugatum*. Indeed, several single ascospore isolates were attempted from a number of strains of *A. conjugatum* in the belief that *M. aurantiaca* might be the asexual state of this species. However, all single ascospore isolates proved to be homothallic (see *Auxarthron conjugatum*).

The occurrence of a single fertile gymnothecium suggests either latent homothallism in one of the two strains tested or heterothallic incompatibility of the type frequently observed in some Gymnoascaceae. Incompatibility results in infertile crosses between F1 progeny and parent strains and between wild-type isolates crossed with each other or with tester strains of the opposite mating type. In the latter case, wild type isolates may only cross with the more fertile progeny of the parent strains (Kwon-Chung, 1971, 1972; Padhye and Carmichael, 1971, 1973).

Figure 12. *Malbranchea aurantiaca* (A,B-UAMH 3704; C,D,H-1707; E,G-3599; F-3705; I,J-2844; K-1707x3599). Figs. 12A-12D. Colonial morphology after 21 days. A and C on PYE, B and D on cereal; C,D at 37 C, others at 25 C. Figs. 12E-12J. Alternate arthroconidia of curved branches and straight primary hyphae. Fig. 12K. Zone of inhibition in cross of 1707x3599 inoculated in separate parallel streaks. Colonies x 0.7, others x 600.

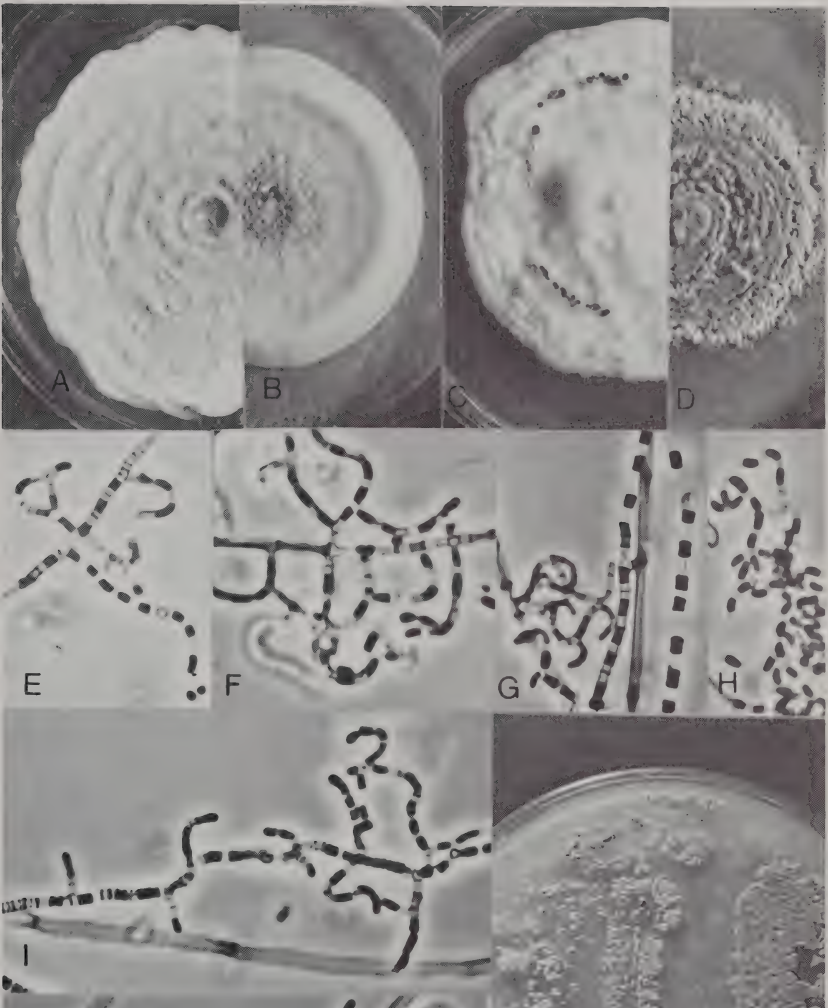
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TABLE II
INCOMPATIBILITY AMONG CROSSES OF MALBRANCHEA AURANTIACA

STRAIN	1707	1709	1778	1853	2844	3524	3599	3660	3704	3705
1569	I	I	-	NI	-	-	NI	NI	-	-
1707		I	-	I	-	NI	I	NI	-	+
1709			NI	-	-	-	NI	I	-	-
1778				-	-	-	-	-	-	-
1853					-	-	NI	-	-	NI
2844						S	-	-	-	-
3524							NI	-	S	NI
3599								I	S	NI
3660									I	NI
3704										NI

Legend:
- No gymnothecia formed on duplicate crosses
+ Single fertile gymnothecium formed on mixed suspension plate
NI Narrow zone of inhibition (<3 mm) and no gymnothecia
I Moderate zone of inhibition (>3 mm) and no gymnothecia
S Zone of stimulation at interface of mating strains

SEE ERRATA

Material Examined
From soil: UAMH 1569, chicken feeding ground, Tonasi, Panama, coll. H.P. Puri, isol. G.F. Orr (0-2505); UAMH 1705, garden, Tonasi, Panama, G.F. Orr (0-2535); UAMH 1707, chicken feeding ground, Tonasi, Panama, G.F. Orr (0-2531); UAMH 1709, Calif., G.F. Orr (0-584); UAMH 1710, pig yard, Tonasi, Panama, G.F. Orr (0-2534); UAMH 1778, from mixed culture rec. as 288c (soil, Guatemala) from Orr; UAMH 1853, Aust., Warcup, (Orr 0-3598; A 270 1); UAMH 2844, Belgium, C. De Vroey, 1966, (Orr 0-3178); UAMH 3660, Ellice Island, Alaska, (Orr 0-3035); UAMH 3818, Italy, E. Varsavsky (I36) from Orr (0-3437); UAMH 3878, Inogmar area, Calif., (Orr 0-683); 0-3482, Somalia, C. DeVroey (RV 20443) from Orr; 0-2592, Panama, from Orr; From dung: UAMH 3483, mouse, India, (Orr 0-3150); UAMH 3524, rat, India, (Orr 0-3733; NRRL A-19283); UAMH 3704, rat, India, (Orr 0-1163); UAMH 3053, lizard, Chihauhua, Mexico, R.K. Benjamin, 1964, RSABG, as 1468; From other sources: UAMH 3599, TYPE, air? (plate contaminant), Dugway, Utah, G.F. Orr (0-1526); UAMH 3705, plate contaminant, Dugway, Utah, G.F. Orr (0-3214); UAMH 3879, hair from ringworm lesion on horse, Riverton, Utah, (Orr 0-3710)

Malbranchea chrysosporoidea Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25 C rapide crescunt, tangerinae, densae, pulveraceae vel velutinae, cum zonis concentricis. Incrementum restrictum ad 37 C.
Aleurioconidia copiosa, truncata in basibus, paula crassiora quam hyphae, 2-3 x (2.5)3-3.5(6.5)um.
Arthroconidia cylindrico-truncata, hyalina, laevia denique aurantia, (1.5)2-4 x (2)3-9(13)um.
Typus: UAMH 1032, ex solo, Arizona, C.W. Emmons, E5003

Colonies on PYE (Fig. 13A) are 66-83 mm diam. in 21 days, characteristically bright tangerine orange, center and periphery often white or pale yellow, reverse orange. The surface is dense, powdery or velvety, with a downy or floccose central umbo, slightly raised, scarcely zonate, showing color changes from dark orange center to light periphery, or distinctly zonate with 6 or 7 concentric zones, and thin, floccose, white or pale orange margin. No pigment is apparent but most strains formed yellow, orange or white exudate droplets. At 37 C, growth on PYE is more restricted (Fig. 13C) (25-31 mm diam. in 21 days) adhering poorly to the cellophane, center lifting up, becoming convoluted or folded, dark tan, brown, or tawny, powdery, and new surface growth downy, orange. Colonies remaining firmly attached to the cellophane are orange-buff, 44 mm in diam.

Colonies on cereal (Fig. 13B) are 61-68 mm diam. in 21 days, flat, ± small central umbo, powdery or granular, patchy or dense, often sectoring, scarcely zonate, dark orange center, tawny to yellow at periphery, reverse orange. At 37 C, growth is slower (18-36 mm diam. in 21 days), orange or buff, rarely white, granular or downy, flat, with a brown diffusing pigment (Fig. 13D).

Fertile hyphae bearing arthroconidia are of two types. Straight, slightly broader, branched primary hyphae, 2-4um wide, develop intercalary arthroconidia (Figs. 13E,13F), and later form multiple straight or curved, deflected lateral branches. The fertile branches (Fig 13E,13I) bear intercalary arthroconidia which intergrade with aleurioconidia formed terminally or directly on the sides of the hypha. The width of the arthroconidia and aleurioconidia forming on a hypha is identical with that of the hypha. Intercalary arthroconidia are cylindrical-truncate, hyaline, later pale orange, orange in mass, (1.5)2-4 x (2)3-9(13)um. Aleurioconidia are smooth, hyaline, later pale orange, orange in mass, cuneiform 2-3 x (2.5)3-5.5(6.5)um. No other spore state was observed.

Discussion

This species is intermediate between *Malbranchea* and *Chrysosporium*. Though formation of aleurioconidia is characteristic of *Chrysosporium*, arthroconidia may predominate in degenerate strains. The aleurioconidia of *Chrysosporium* are mostly subglobose, pyriform or clavate, and wider than the diameter of the supporting hypha. Though this distinction appears somewhat arbitrary, it is difficult to assign this species with assurance to either *Malbranchea* or *Chrysosporium*. Several characters favor its placement in *Malbranchea*: the width of the aleurioconidia and intercalary arthroconidia does not exceed that of the supporting hypha; intercalary arthroconidia predominate in the primary hyphae, consistent with other species of *Malbranchea*; the diameter of the fertile hyphae fits well within the rather narrow range for *Malbranchea*. Interestingly, vivid orange colonies occur in at least three other species of *Malbranchea*, whereas most *Chrysosporium* colonies are white or light colored, green,

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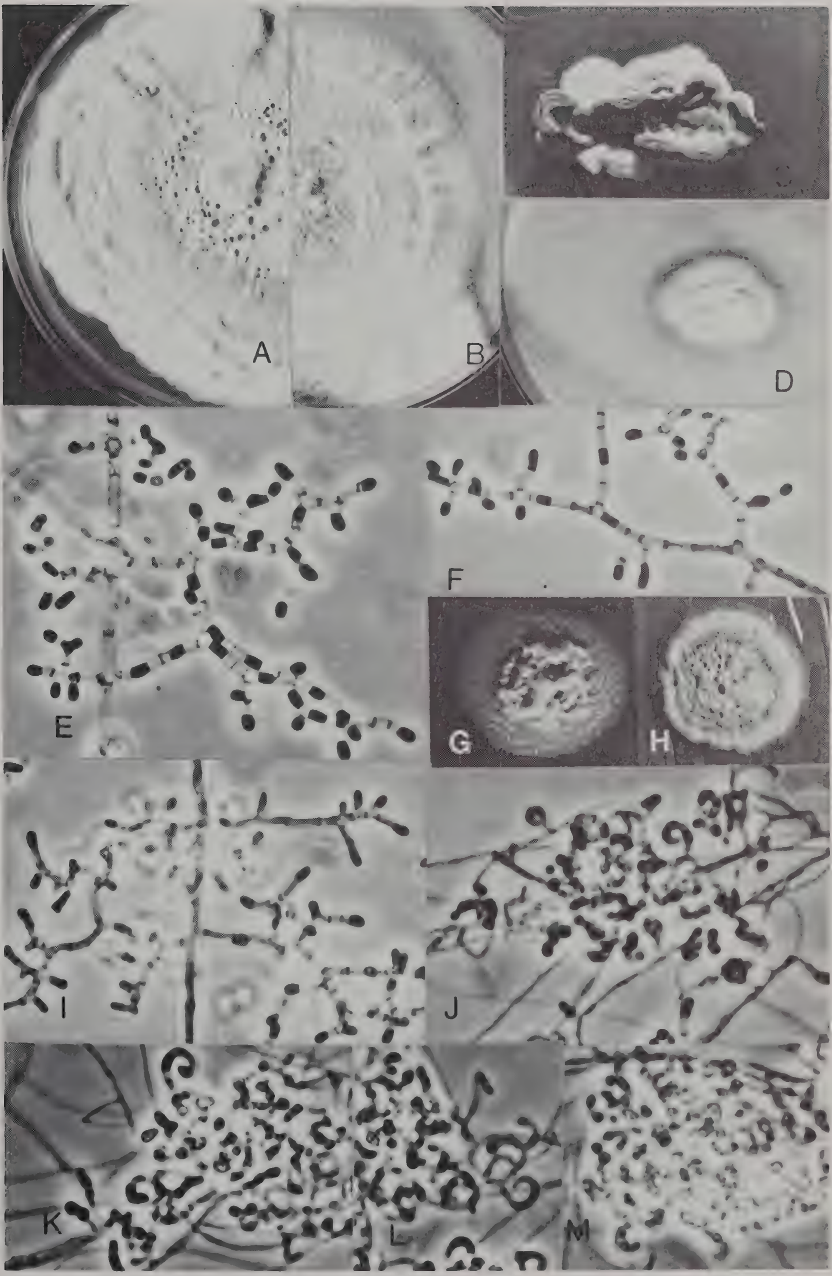
Figure 13. A-F, I. *Malbranchea chrysosporoidea* (A-D-UAMH 1032; E,F,I-1031). G,H,J-M. *Malbranchea circinata* (G-H,J,M-1890; K,L-3589). Figs. 13A-13D. Colonial morphology after 21 days. A and C on PYE, B and D on cereal. C and D at 37 C, others at 25 C. Figs. 13E-13F. Aleurioconidia and intercalary arthroconidia. Figs. 13G-13H. Colonial morphology after 21 days at 25 C. G on PYE, H on cereal. Fig. 13I. Lateral or terminal aleurioconidia and intercalary arthroconidia. Figs. 13J-13M. Coiled conidiogenous hyphae. Colonies x 0.65, others x 600.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brown, grey, buff, occasionally pale orange or orange-buff.

Habitat and activities: Recorded from soil, dung or air samples, Maryland, Utah, Hawaii, Arizona, South Carolina, California (Orr, 1970, 1972), Japan and India. One strain was recovered from omental abscesses and the spleen after experimental intra-peritoneal inoculation of soil into mice. Slight or no digestion of keratin, not cellulolytic.

Material Examined
From soil: UAMH 1031, Ariz., C.W. Emmons (E5002), (Orr 0-1524; same strain as UAMH 2786?); UAMH 2786, omental abscesses in mice inoculated with soil, Bethesda, Md., C.W. Emmons (E5002), 1958, from Kwon-Chung, N.I.H., Bethesda; UAMH 1032, TYPE, Ariz., C.W. Emmons (E5003), from Orr (0-1525); UAMH 2288, bean garden, Shokuku, Japan, G.F. Orr; UAMH 2740, India, from H.C. Gugnani, National Institute of Communicable Disease, New Delhi, as S536; UAMH 3570, S. Carolina, from Orr (0-3517); UAMH 3876, Oahu, Hawaii, E. Varsavsky (9), from Orr (0-3295); Soil isolates from Orr: 0-3224, Maui, Hawaii, E. Varsavsky (7); 0-3377, Calif.? E. Varsavsky (20); 0-3381, Kauai, Hawaii, E. Varsavsky (18); 0-3398, Oahu, Hawaii, E. Varsavsky (21); 0-3399, Maui, Hawaii, E. Varsavsky (25); From other sources: UAMH 1060, coyote dung, Kern Co., Calif., G.F. Orr (0-837; NRRL A-10663); UAMH 1241, plate contaminant, Edmonton, 1962; UAMH 2051, Hawaiian Islands, soil?, from Varsavsky, CDC, as KAVAI-18; UAMH 2850, wind tunnel contaminant, Utah, G.F. Orr, 1967, (9BR5); UAMH 3856, spore mass, Dugway, Utah, from Orr (0-3077); NRRL 6087, from Ellis

Malbranchea circinata Sigler & Carmichael sp. nov.
Perfect State: *Myxotrichum* Kunze

Coloniae in agaro ad 25 C lente crescunt, cremeae vel aurantiae, floccosae vel velutinae, ad marginem mucosae. Incrementum minus ad 18 C vel 30 C, nullum ad 37 C. Arthroconidia cylindrica, curva, laevia, initio hyalina, dein flava, flavo-brunnea, chlorina vel purpurea, 2-3 x 3-5um.
Status perfectus: *Myxotrichum*, sed species incerta est. Ascosporae non visae sunt.
Typus: UAMH 1890, ex solo, Dugway, Utah, G.F. Orr, 0-1103 (DPG 111)

Colonies on PYE (Fig. 13G) are 29 mm diam. in 21 days, pale creamy yellow, reverse yellow, floccose tufts of hyphae at center, and wide (4-8 mm) margin of slimy tufted surface growth. On cereal, colonies (Fig. 13H) (diam. as on PYE) are more luxuriant, dense, velvety, smooth with a narrow slimy margin, dark gold, reverse yellow. Brown exudate droplets on surface dry and leave surface pitted; reddish brown pigment diffuses into the medium. No growth

SEE ERRATA

at 37 C; optimum 25 C.

The conidiogenous hyphae (Figs. 13J-12L), arising as lateral branches wider than the narrow vegetative hypha, are tightly coiled or curved, closely spaced, eventually forming a dense cluster (Fig. 13M). Arthroconidia are smooth, cylindrical, curved, kidney-shaped or ovate, almost discoid in end view, pale yellow, or yellowish-brown, in age purple or dark yellow-green, 2-3 x 3-5um. No arthroconidia develop on the primary hyphae.

Gymnothecia (Fig. 14A) are dark brown, almost black, discrete, 350-450um in diameter, excluding appendages, spherical but tending to coalesce, not easily dislodged from the conidiogenous hyphae. Peridial hyphae are dark brown, thick-walled, smooth, continuously branched, terminating in 'antler-like' appendages (Figs. 14A,14C-14E) with narrow delicate branchlets (Figs. 14C,14D), pointed toward the perimeter. Appendages of a second type are uncinate (Figs. 14A,14C), sparingly septate, thick, smooth walled, 100-200um long, 5-7um wide at the tip and the same diameter or slightly narrower at the base. The uncinate appendages arise at the center or near the periphery from a bifurcate base with the other branch terminating in the 'antler-like' appendage (Fig. 14C). No ascospores were found. When the gymnothecium is crushed, yellow-green or purple, coiled conidiogenous hyphae in the centrum give the impression of asci, and the mature kidney-shaped or ovate conidia can be mistaken initially for ascospores.

Discussion

The formation of gymnothecia corresponded to sectoring of the colonies on oatmeal agar at 25 C (Fig. 14B). Indeed, gymnothecia consistently formed along the interface of the sector, which was white with sparse aerial growth and glabrous margin, compared to the remainder of the colony which was yellowish-brown, powdery and dense with abundant conidial formation. Transfers from the sector to fresh oatmeal agar produced a degenerate colony with scant aerial growth, pale color, and scant sporulation. Transfers from the powdery yellow-brown portion yielded similar, profusely sporulating colonies which eventually sectored. A transfer of a single gymnothecium yielded again a sectoring colony developing gymnothecia along the interface. Formation of gymnothecia in sectors has also been recorded for atypical colonies of *M. stipitatum* (Orr *et al.*, 1963b). Attempts to stimulate ascospore production by mating were unsuccessful, only two isolates being available. Gymnothecia occurred only when colonies were grown on a cellophane membrane, not on oatmeal agar alone.

In the absence of ascospores, it is difficult to relate this species to any described *Myxotrichum* species.

Although our cultures of M. carminoparum Robak (Orr et al., 1963b) (UAMH 1597 and 1906) also have failed to produce ascospores, this species differs in its conidial state, which lacks the coiled conidiogenous hyphae of M. circinata and in its colonial morphology. At 25 C, the colony of the type strain (UAMH 1597, CBS 224.31) is sparse and restricted and the observation of Orr et al. (1963b) of growth at 7 C ± 2 C suggests a lower optimum temperature for growth. The peridial hyphae of M. chartarum, 'witches-broom-like' (Orr et al., 1963b) are somewhat similar but the terminal branchlets are more spiny and less delicate. Although M. chartarum has an arthroconidial asexual state, the conidiogenous hyphae are not coiled.

Habitat and activities: Recorded only from soil, Utah (Orr and Kuehn, 1972). Cellulolytic, not keratinolytic. Hairs on DSA become purple in color after three weeks from the diffused pigment.

Material examined: UAMH 1890, TYPE, soil, Dugway, Utah, G.F. Orr (0-1103; DPG 111); UAMH 3589, soil, Terra, Utah, from Orr (0-3225; DPG 118)

Malbranchea flavorosea Sigler & Carmichael sp. nov.
Perfect state: Myxotrichum Kunze

Coloniae in agaro ad 25-30 C moderatim lente crescunt, cremeae, in centro fulvae vel roseo-fulvae, floccosae vel velutinae. Incrementum nullum ad 37 C.
Arthroconidia cylindrica, frequenter curva, laevia, hyalina, 1.5-2 x 3-5um, in senectute inflata, subglobosa.
Status perfectus: Myxotrichum, sed species incerta est. Ascosporae non visae sunt.
Typus: UAMH 1051, ex solo, Riverside County, California, G.F. Orr, 0-643

Colonies on PYE are 29-32 mm diam. in 21 days, adhering poorly to the cellophane, lifting up at the margin

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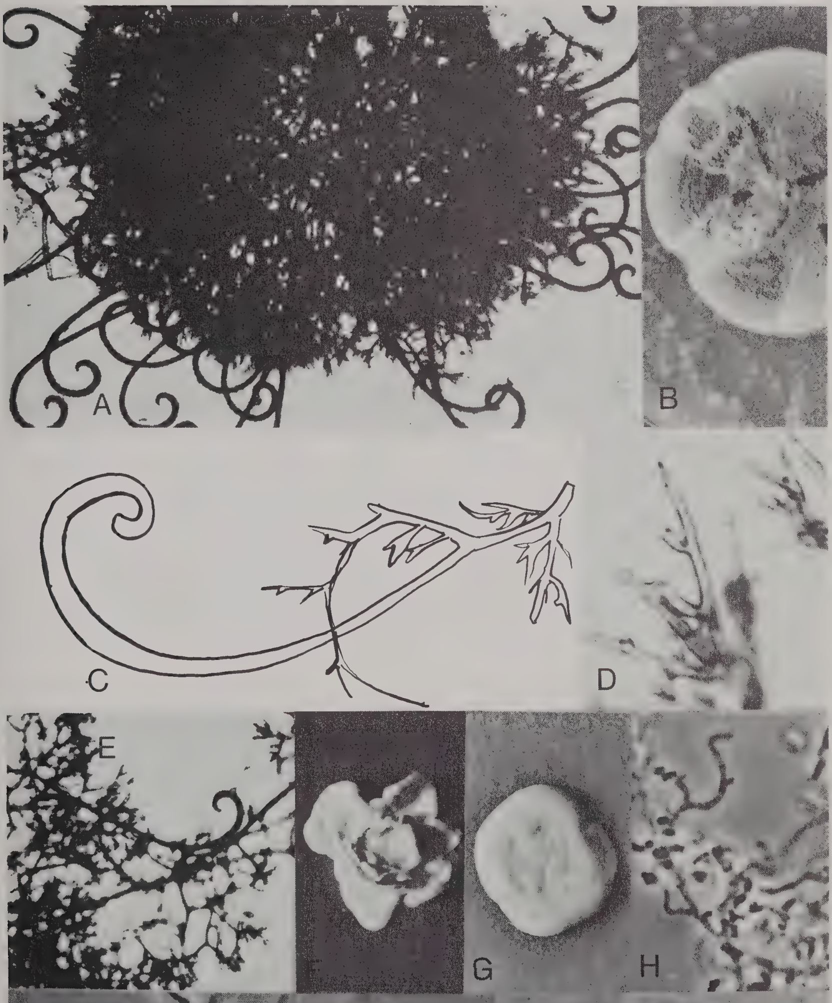
Figure 14. A-E. Malbranchea circinata (A-UAMH 3589; B-E-1890). F-J. Malbranchea flavorosea (F-H-1051; I,J-1065). Fig. 14A. Gymnothecium bearing uncinate appendages, x 150 BF. Fig. 14B. Sectoring on oatmeal agar after 35 days at 30 C, x 0.7. Fig. 13 C. 'Antler-like' and uncinate appendages, x 480. Fig. 14D. 'Antler-like' appendages, x 960 BF. Fig. 14E. Coalescing peridial hyphal appendages of both types, x 150 BF. Figs. 14F-14G. Colonial morphology after 21 days at 25 C, x 0.65. F on PYE, G on cereal. Figs. 14H-14I. Curved fertile hyphae bearing alternate arthroconidia, x 600. Fig. 14J. Gymnothecia (minute black specks) formed at the center and near the periphery after 42 days at 25 C on oatmeal agar, x 0.65.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and curling toward the center to form a distinct petaloid pattern (Fig. 14F). New growth extends unevenly below margin. The surface is creamy white, buff in center, reverse dark tan in center, yellow at the periphery, velvety. On cereal, colonies (Fig. 14G) (diam. as on PYE) are flatter, pinkish-buff, floccose, with diffusing dark brown pigment. No growth at 37 C; optimum range 25-30 C.

On oatmeal agar, colonies (Fig. 14J) (optimum 25 C) become deep rose pink in center with paler margin, floccose, crateriform. Gymnothecia form most abundantly at 18 C, developing at the center and close to the periphery (Fig. 14J).

Arthroconidia developing on short, loosely curved or arcuate lateral branches (Figs. 14H,14I) are cylindrical, often curved, hyaline, smooth, 1.5-2 x 3-5um. In age, arthroconidia become swollen, rounded or subglobose.

Gymnothecia are spherical, approximately 400-600um, discrete, black (Fig. 15A), composed of a network of smooth, thick-walled, septate, dark-brown peridial hyphae, 5-6um wide, having blunt tips and lateral bluntly pointed spines along the length reflexed at an acute angle toward the center (Fig. 15B). The blunt tipped ends of the peridial appendages extend 120-200um beyond the densely branched center (Fig. 15A). No other appendages are formed. Asci and ascospores were not observed.

Discussion

Neither of the two strains studied developed ascospores even after prolonged growth and multiple transfers. Attempts to cross the two isolates were unsuccessful. A third strain (UAMH 3909, NRRL 6088) received late in the study also failed to develop ascospores. No isolation data was provided with this strain. Since it was deposited by G.F. Orr in NRRL, it could be the same strain as either UAMH 1051 or 1065.

The sexual state of this species is assigned to Myxotrichum primarily on the morphology of its dark brown peridial hyphae. In the absence of ascospores, a specific epithet has not been chosen, nor can the isolates be assigned with certainty to any known species. Although superficially resembling *Myxotrichum deflexum* Berkeley (Ann. Nat. Hist. 1:260, 1838), this species differs in several respects. First, the gymnothecia are much larger, 400-600um, compared to 100-400um for *M. deflexum* (Orr *et al*., 1963b; Apinis, 1964); the appendages of *M. deflexum* are narrow, 1.4-1.8um (Orr *et al*., 1963b) or up to 3um (Apinis, 1964), with lateral branches, deflected either upward or downward, having hyaline blunt apices, whereas those of this species are wider, 5-6um in diameter, with lateral bluntly pointed spines, brown, branched consistently downwards (Fig. 15B); finally, a conidial state has not been observed for *M. deflexum* (Orr *et al*., 1963b; Apinis, 1964).

Other characters of this species are also common to *Myxotrichum*. Orr *et al*. (1963b) reported cessation of growth at 37 C for all *Myxotrichum* species, characteristic reddish-brown diffusing pigments, and pink or reddish colonies in species such as *M. aeruginosum*, *M. deflexum* and *M. stipitatum*. In addition, this species is cellulolytic, as are other species of *Myxotrichum*.

Material examined: UAMH 1051, TYPE, soil, Riverside Co., Calif., G.F. Orr (O-643); UAMH 1065, lung, kangaroo rat, Palo Verde, Calif., from Orr (O-647); UAMH 3909 (NRRL 6088)

Malbranchea pulchella Saccardo & Penzig 1882
Michelia 2:638

Synonyms

= *Malbranchea bolognesii-chiurcoi* Vuillemin, Pollacci & Nannizzi 1925, in Bolognesi & Chiurco, Archivi di Biologia 1:255-276
  ≡ *Actinomyces bolognesii-chiurcoi* (Vuill. *et al*.) Dodge 1935, Medical Mycology p. 766
= *Malbranchea kambayashii* Kambayashi 1934, Archiv fur Dermatologie u. Syphilis 170:97-106

History

Saccardo (1882) described *Malbranchea* with a single species *M. pulchella* Sacc. & Penz., reiterating his description in 1886. Saccardo (1908) and Saccardo and Trotter (1913) reduced Miehe's (1907) thermophilic *Thermoideum sulfureum* to synonymy with *M. pulchella*.

Two other species were described, *M. bolognesii-chiurcoi* Vuill., Poll. & Nann. in Bolognesi and Chiurco (1925) and *M. kambayashii* Kamb. (1934). Baldacci, Ciferri and Vaccari (1939) reviewed both and reduced them to synonymy with *M. pulchella* after comparing the cultural and microscopic characteristics of four isolates: *M. pulchella* from Buisman, *M. bolognesii-chiurcoi* from Bolognesi and Chiurco (1925) and Rivelloni (1938), and *M. kambayashii* from Kambayashi (1934). With the exception of the Rivelloni strain which showed scant growth, all failed to grow at 37 C. Furthermore, the authors could find no reason to justify Dodge's (1935) transfer of *M. bolognesii-chiurcoi* to *Actinomyces*.

Elisei (1940a), in a similar examination of *Malbranchea*, reviewed the literature and studied the same four isolates. He revised the genus, concurring with

Saccardo (1908) in placing *T. sulfureum* in synonymy with *M. pulchella*. Elisei also observed a number of microscopic features not previously recorded, including nodular organs, spiral hyphae, and pectinate bodies. These were later reviewed (Elisei, 1940b) in comparison to some dermatophytes.

Few reports of other *Malbranchea* species are cited in the literature. In 1913, Sumstine transferred *Rhinotrichum pulveraceum* Ellis to *Malbranchea* as *M. pulveracea*. Linder (1942) disagreed and proposed the combination *Oidium pulveraceum* because the conidia were borne in chains on short denticles. Clamp connections on the hyphae indicate that this species is a conidial state of a Basidiomycete genus.

Cooney and Emerson (1964), studying a thermophilic isolate of *Malbranchea*, proposed a new variety *M. pulchella* var *sulfurea*. However a number of characters differentiate the mesophilic *M. pulchella* from the thermophilic isolates, suggesting that the latter should be distinguished as a separate species.

More recently, Wang (1965) again described and illustrated a mesophilic *Malbranchea pulchella* isolate from a pulp sample. Von Arx (1970) stated that *Malbranchea* included 3 or 4 species, but named only *M. pulchella*.

Description

Colonies on PYE (Fig. 15C) are 26-33 mm diam. in 21 days, either flat, margin entire, or convoluted, lifting at the center or at the margin with new growth below, lobate and undulate. Colonies are tan or pale brown, occasionally white, reverse tan or yellow, downy or velvety, occasionally with white exudate droplets. On cereal, colonies (Fig. 15D) (diam. as on PYE) are downy or velvety, tan, buff or white, reverse pale or dark tan or yellow, and adhere more firmly to the cellophane, remaining flat with central umbo and few outward radiating folds, or dome-shaped. Droplets of white or brown exudate sometimes form on the surface, and a brown pigment diffuses into the agar. Good growth occurs at 30 C; no growth at 37 C.

Fertile hyphae, arising as short lateral branches from the narrow (1-2um wide) vegetative hyphae, form multiple branches which are tightly coiled, arched, or curved (Figs. 15E-15H). Arthroconidia are cylindrical, curved, hyaline, in mass tan, smooth 1.5-3 x 2-6.5um, mostly 1.5-2.5 x 2.5-5um. Accessory arthroconidia are rarely formed by segmentation of the primary hyphae.

Typical strain: from pulp sample at paper towel mill,
N. Y. State, 1959, C.J.K. Wang, UAMH 1560

Discussion

Considerable variation was initially evident among isolates received as M. pulchella. A comparison of Saccardo's description with photomicrographs from a slide (ex DAOM 41374) of the type, indicated to us that some of these isolates should be excluded (see Malbranchea flocciformis and M. flavorosea). Arthroconidia of DAOM 41374 measure 1.5 x 2-4um. Of the remaining isolates, UAMH 3794 (strain Kambayashi) differs from the others in forming larger arthroconidia (2.5-3 x 4.5-6um) and wider primary hyphae (3um) which fragment to form accessory arthroconidia. However, this strain resembles the others in colonial morphology and inability to grow at 37 C.

UAMH 3783 (strain Rivelloni) failed to grow at 37 C although Baldacci et al. (1939) reported slight growth. Also the size of the arthroconidia, 2.5-3 x 3.5-6.5um differs slightly from the measurements given by them (3-4 x 6.5-7.5um), but variations could be expected in view of the prolonged maintenance of this isolate. Indeed, Cooney and Emerson (1964) reported no sporulation at all. In UAMH 3907 (strain M. bolognesii-chiurcoi), production of arcuate fertile hyphae was weak. However, this strain was initially contaminated with bacteria and failed to sporulate. When it was freed from contamination, it sporulated after prolonged growth on cereal agar. However, the culture appears to be somewhat degenerate. Baldacci et al. (1939) reported arcuate hyphae in the type strain of M. bolognesii-chiurcoi. None of these three strains corresponds exactly with the typical strain. However, all three more closely resemble M. pulchella than any other species described herein.

In general, the following characters distinguish M. pulchella from other species: buff or tan slow growing colonies, no growth at 37 C, lack of accessory arthroconidia and presence of cellulolytic activity.

Habitat and activities: Reported from cardboard (Saccardo, 1882), France; pulp (Wang, 1965), USA; wallpaper; human sources in Italy, China, Sardinia (Baldacci et al., 1939; Cooney and Emerson, 1964); nests and feathers of birds, Czechoslovakia and Yugoslavia (Hubalek, Balat, Touskova and Vik, 1973; Hubalek, 1974a,b). Slightly cellulolytic. A single strain (UAMH 3189) also digested keratin slightly with single hyphae penetrating the hair.

Pathogenicity: Cooney and Emerson (1964) noted that experimental inoculation by Vuillemin, Pollacci and Nannizzi into white rats, and by Kambayashi into guinea pigs, reaffirmed the pathogenicity of their isolates from human sources. However, similar experiments by Rivelloni were unsuccessful in demonstrating pathogenicity.

Material Examined

UAMH 643 & 1191, photomicrographs of slide (ex DAOM 41374) of TYPE, wet cardboard, Rouen, Fr.; UAMH 1560, from pulp sample at a paper towel mill, N.Y. State, 1959, C.J.K. Wang, State Univ. of N.Y., Syracuse; UAMH 3189, card, Gravesend, England, P. Russell (BS421), 1954, (CMI 57206); UAMH 3783, CBS 204.38, from Ciferri as 'ceppo Rivelloni'; UAMH 3794, CBS 203.38, from Ciferri as *M. kambayashii*, 1938; UAMH 3909, CBS 202.38, from Ciferri as *M. bolognesii-chiurcoi*, 1938

Malbranchea state of *Auxarthron conjugatum*

(Kuehn) Orr & Kuehn in Orr, Kuehn & Plunkett 1963a,
Can. J. Bot. 41:1452

History

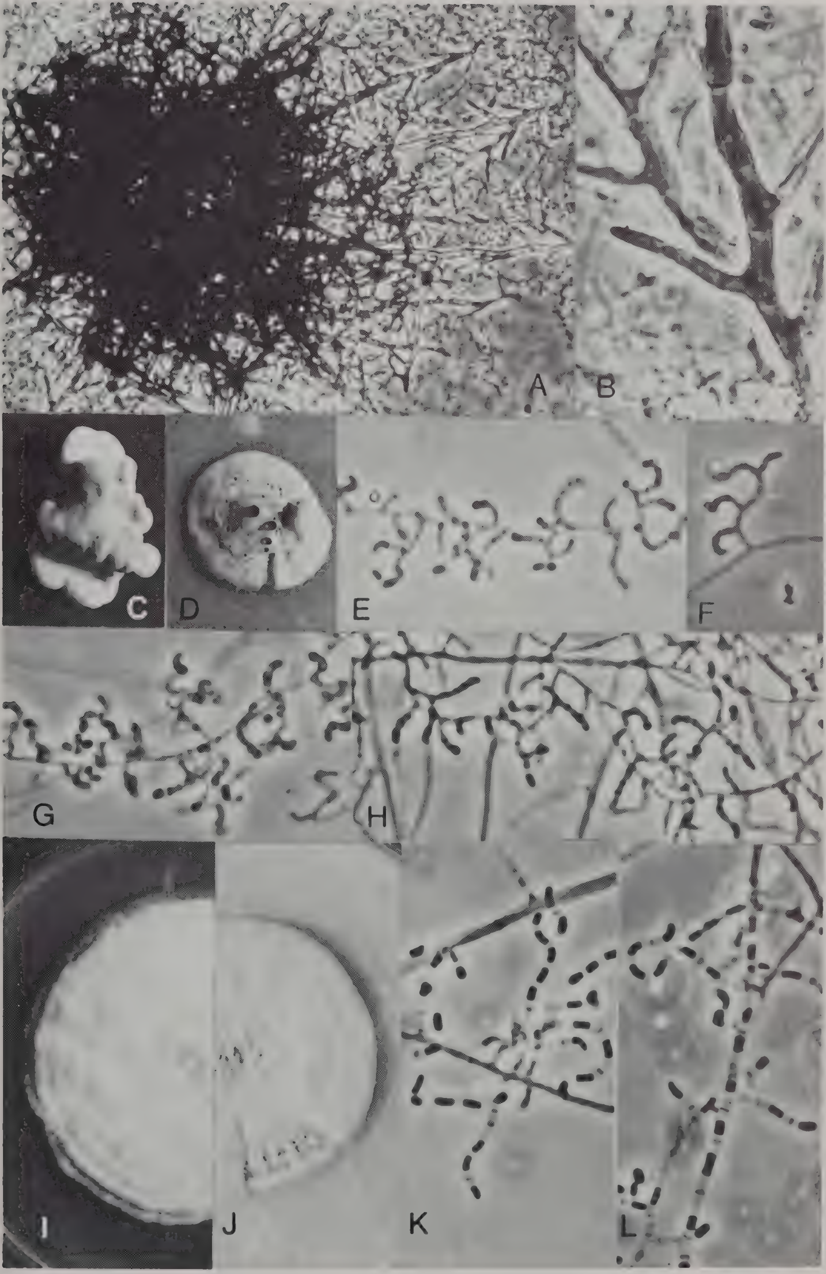
Orr *et al.* (1963a) transferred *Myxotrichum conjugatum* Kuehn (1955b) to *Auxarthron*. De Vroey (1970) referred to an undescribed species of *Auxarthron* isolated from soil in Burundi and his fig. 39 indicates a resemblance to *A. conjugatum*.

Description

Colonies on PYE (Fig. 15I) are 46-59 mm diam. in 21 days, pale yellow-orange or orange-buff, reverse dark orange, dry, powdery, cracked or powdery near the center with downy, creamy white overgrowth and periphery. If mostly powdery, the colony is flat with central downy umbo, otherwise zonate with 7-8 outer zones including the margin. On cereal, colonies (Fig. 15J) are orange-buff, flat, powdery or with downy creamy white to pale orange pleomorphic overgowth, reverse light to dark orange. Gymnothecia form near the center of the colony. Growth at 37 C is slow (7-9 mm at 14 days); colonies are pale orange, heaped up, downy, or velvety, reverse tan or orange.

Arthroconidia borne on narrow, lateral, arcuate

Figure 15. A-B. *Malbranchea flavorosea* (UAMH 1051). C-H. *Malbranchea pulchella* (C,D,F,G,-1560; E,H-3189). I-L. *Malbranchea* state of *Auxarthron conjugatum* (I,J-3817; K,L-3156). Fig. 15A. Gymnothecium composed of dark brown peridial hyphae. Fig. 15B. Peridial hypha with deflected lateral spines. Fig. 15C-15D. Colonial morphology after 21 days at 25 C. C on PYE, D on cereal. Fig. 15E-15H. Coiled or curved conidiogenous hyphae. Fig. 15I-15J. Colonial morphology after 21 days at 25 C. I on PYE, J on cereal. Fig. 15K-15L. Alternate arthroconidia of curved branched and straight primary hyphae. Colonies x 0.7, others x 600, except A, x 150.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branches (Figs. 15K,15L) are cylindrical, curved or straight, smooth, hyaline, in age pale orange, 1.5-2 x 2.5-5um. Arthroconidia formed by segmentation of the broader, straight hyphae (Fig. 15L) are 3 x 3-5um in diameter, often becoming swollen, rounded or subglobose in age (Fig. 16A).

This species is homothallic, and the sexual state has been described in detail by Orr and Kuehn (in Orr et al., 1963a).

Discussion

In early stages of growth, the Malbranchea state of Auxarthron conjugatum closely resembles M. aurantiaca. Both have orange colonies, arcuate fertile hyphae and arthroconidia of a similar size range. Indeed, in order to determine the relationship between the two species, strains of M. aurantiaca were crossed, and single ascospore isolations of several A. conjugatum strains were attempted. However, single ascospore isolates from five strains (UAMH 3130, 3156, 3516, 3517, and 3519) of A. conjugatum were consistently self-fertile. The sexual crosses of M. aurantiaca were negative with the exception of one cross, UAMH 1707 x 3705 (Table II), which formed a single gymnothecium having elongate appendages and containing few spiny, oblate ascospores (see Malbranchea aurantiaca).

In describing Auxarthron conjugatum, Orr and Kuehn (1963a) noted that elongate appendages were straight, hooked or coiled, rarely branched. However, we observed that apical branching of elongate appendages (Fig. 16B) occurred frequently in all strains of A. conjugatum when cultured on a variety of media, including cereal, oatmeal and DSA agar. A single gymnothecium, in addition to branched elongate appendages, also bore some which were unbranched, straight or hooked at the apex.

Orr and Kuehn (1963a) reported that ascospores of A. conjugatum were spherical or ovoid, asperulate, smooth when young but becoming asperulate in age. Our examination indicates that the ascospores are oblate (Figs. 16C,16D), 1.5-2.2 x 2.5-3.2um and very finely roughened. In all strains examined, the asperulate nature of the ascospores is almost beyond the resolution of the phase contrast light microscope. Even at high magnification (x2700), the finely roughened edge of the ascospore is barely discernible (Figs. 16C,16D). Scanning electron microscopy would be required to resolve the exact nature of the ascospore surface.

Habitat and activities: Recovered from soil, dung, feathers and lungs of rodents, USA, Australia, Mexico, India and the Sudan (Orr et al., 1963a). Moderately keratinolytic, with no penetrating bodies, not cellulolytic.

Material Examined

From soil: UAMH 3156, TYPE, Ariz., C.W. Emmons (47), from Benjamin, RSABG as 1530 (NRRL 1244; 0-520); UAMH 3516, Sudan, rec. from Ajello, CDC 32 b; UAMH 3517, Sudan, from Ajello, CDC 32 a; UAMH 3519, Sudan, from Ajello, CDC 28 a; UAMH 3817, India, G. Ghosh, from Orr (0-1236); UAMH 3874, Kansas, from Orr (0-3750); From other substrates: UAMH 3130, lizard dung, Chihuahua, Mexico, R.K. Benjamin, 1964, RSABG as 1474; UAMH 3841, feathers (domestic fowl), Australia, R.G. Rees (F91), from Orr (0-3153)

Malbranchea sulfurea (Miehe) Sigler & Carmichael comb. nov.

Synonyms

= *Thermoideum sulfureum* Miehe 1907, Deutsche Botanische Gesellschaft 25:515 (Basionym)

= *Malbranchea pulchella* var *sulfurea* (Miehe) Cooney & Emerson 1964, Thermophilic Fungi p. 102

History

In 1907, Miehe created a new genus and species *Thermoideum sulfureum* for a fungus he found growing on spontaneously heated compost heaps. By studying the fungus in culture, he not only established the thermophilic nature of the organism but also accurately illustrated and described the formation of conidia. According to Miehe, the curved fertile hypha divided itself into short segments, which later developed an internal thickened membrane to form the spore. In the process, not all the cells became spores, but only alternate ones. Saccardo (1908) and Saccardo and Trotter (1913) reduced *Thermoideum sulfureum* to synonymy with *M. pulchella* without regard for the thermophilic nature of the organism. Elisei (1940a) examining four mesophilic strains, followed Saccardo (1908) in placing *T. sulfureum* in synonymy with *M. pulchella*.

In 1964, Cooney and Emerson reviewed the history of *Malbranchea* and provided an excellent account of the morphology of a thermophilic strain isolated by Emerson in 1945. Their fungus corresponded in appearance to the description of the thermophilic *Thermoideum sulfureum* of Miehe (1907). A comparison with the study of Baldacci *et al.* (1939) of four mesophilic isolates indicated that these organisms differed at least in temperature relations. Cooney and Emerson examined a single mesophilic strain (strain Rivelloni) which failed to sporulate and they were unable to make a definite distinction between the thermophilic and mesophilic isolates. Therefore they proposed a new variety for the thermophilic isolates, *Malbranchea pulchella* var *sulfurea* (Miehe) until a more comprehensive comparison of the mesophilic and thermophilic strains could be made.

An examination of a number of isolates indicated that the thermophilic strains are specifically distinct from the mesophilic M. pulchella and therefore a new combination is proposed here.

Description

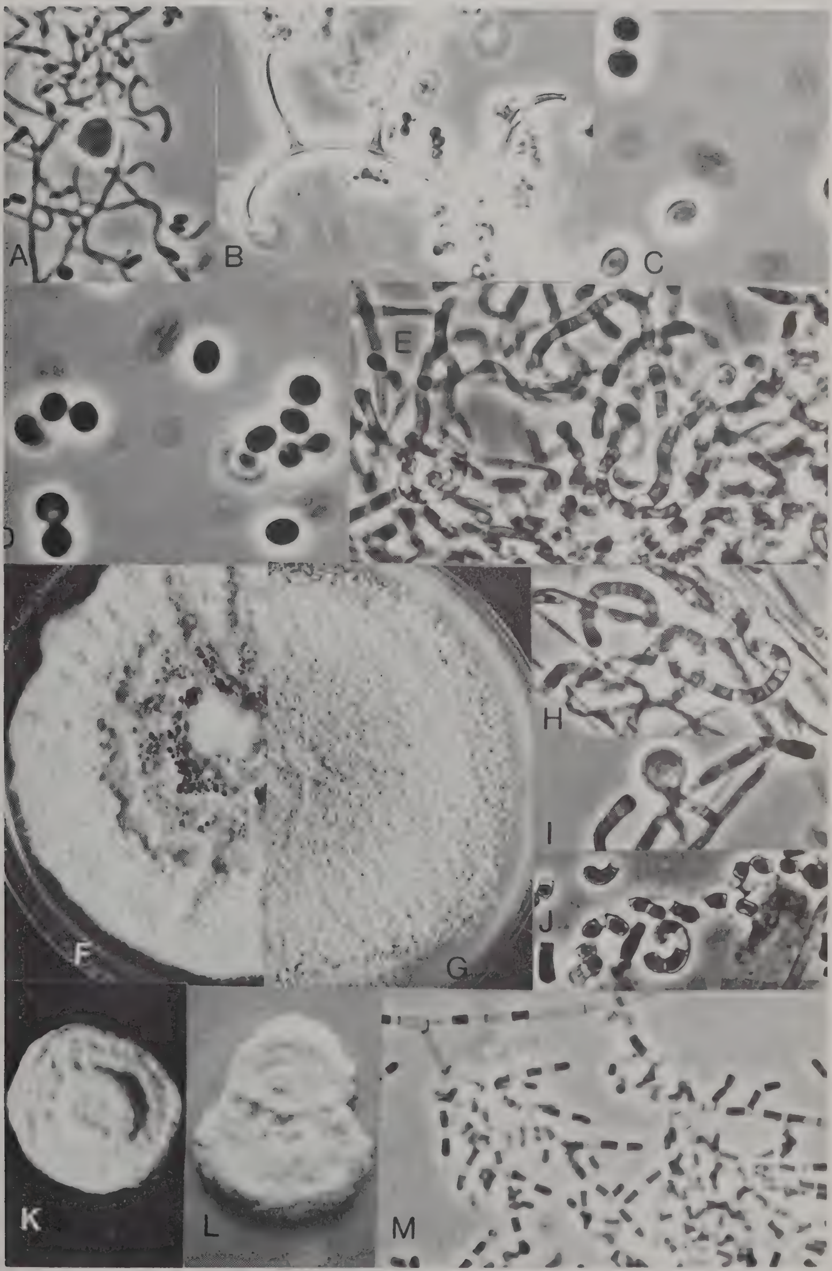
At 45 C, colonies (Fig. 16F) on PYE are robust, almost or completely filling the petri dish by 7 days, dense, thick, smooth or with few outward radiating folds, velvety with coarse, creamy yellow tufts of hyphae. The color is sulfur-yellow or yellowish-tan, with yellow or pink margin, by 21 days dark gold, buff-brown or deep reddish-brown. Large droplets of dark brown exudate, which appear on the surface by 7 days (Fig. 16F), gradually dry and leave the surface pitted and mealy. The medium turns dark brown or black from diffused pigment. At 37 C, growth is slightly slower (70-78 mm in 7 days), sulfur-yellow with darker tan center, otherwise similar to colonies at 45 C. Pigment production is slightly reduced.

At 45 C, colonies (Fig. 16G) on cereal are 79-81 mm diam. in 7 days, sulfur-yellow, flat, coarse, and mealy with tufts of yellow hyphae, and yellow to dark brown exudate droplets which dry and leave the colony pitted. By 21 days, the colony is dark tan or reddish-brown, with diffusing dark brown pigment, dense, velvety, thick, smooth often with few irregular folds. Growth at 37 C is slightly slower, but otherwise similar.

Degenerate or less robust strains (UAMH 2481, 2486, and CBS 423.54) are greenish-grey or drab-grey, glabrous, hairy or leathery with scant aerial growth. Diffusing pigment is scant.

The arthroconidia are borne on curved or loosely

Figure 16. A-D. Auxarthron conjugatum (A,B,D-UAMH 3156; C-3817). E-J. Malbranchea sulfurea (E,I,J-2485; F,G-3748; H-2486). K-M. Malbranchea dendritica (2731). Fig. 16A. Enlarged arthroconidia and curved conidiogenous hyphae. Fig. 16B. Apical branching of elongate peridial appendage. Figs. 16C-16D. Oblate, finely asperulate ascospores. Fig. 16E. Alternate arthroconidia borne on curved or coiled branches. Figs. 16F-16G. Colonial morphology after 7 days at 45C. F on PYE, G on cereal. Fig. 16H. Curved conidiogenous hyphae. Fig. 16I. Thick-walled chlamydospore. Fig. 16J. Thick-walled mature arthroconidia. Figs. 16K-16L. Colonial morphology after 21 days at 25 C. K on PYE, L on cereal. Fig. 16M. Branching at an acute angle of fertile hyphae. Colonies x 0.7, others x 600, except C and D, x 1680.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coiled lateral branches (Figs. 16E,16H) arising from broader vegetative hyphae (3-6um in diameter). The vegetative hyphae are hyaline, later yellowish-brown with prominent racket hyphae, swelling at the septum to a diameter of 9um or more. In some strains, thick-walled intercalary or terminal chlamydospores (Fig. 16I) occur, especially at 45 C. Arthroconidia (Fig. 16J) are cylindrical, often curved, thick-walled, often with attached hyaline frill from the outer hyphal wall of the separating empty cell, hyaline at first, later yellow, tan or yellowish-green (2)2.5-4(4.5) x (3)3.5-7.5(8.5)um, mostly 3-4 x 4-7um.

Discussion

Cooney and Emerson (1964) and Awao and Otsuka (1973) also describe the morphology of this species.

_M_. _sulfurea_ differs from _M_. _pulchella_ in its thermophilic nature, its colonial morphology, its broader vegetative hyphae and its thick-walled, broader arthroconidia. In its capacity to grow at high temperature, _M_. _sulfurea_ is distinct from all other species of _Malbranchea_. Furthermore, chlamydospores are formed regularly. No other spore state was observed and attempts to mate the isolates by pairing them on oatmeal agar at 37 C in 3% CO2 were unsuccessful.

Occurrence: Reported from plant heaps and rotting plant material: guayale rets, California (Cooney and Emerson, 1964); composting heaps, Germany, Texas (Miehe, 1907; Rode, Foster and Schuhardt, 1947); wheat straw compost, England (Chang and Hudson, 1967) and stacked tobacco leaves, South Africa (Eicker, 1972). It has been isolated from soil in Japan (Awao and Otsuka, 1973; Tubaki, Ito, Matsuda and Yano, 1975); peanut kernals and associated soil, Texas (Taber and Pettit, 1975); coal spoil tips, England (Evans, 1971); faeces of Cape sparrow, South Africa (Eicker, 1972); dung of deer, Japan (Minoura, Yokoe, Kizima, and Nehira, 1973) and cattle, Alberta; hen-house litter, Netherlands; snuff, USA, (Tansey, 1975) and from air sample surveys, England (Hudson, 1973). _M_. _sulfurea_ is notably absent from self-heating wood chip piles (Shields, 1969; Tansey, 1970 (Abstract), 1971b; Smith and Ofosu-Asiedu, 1972).

Growth rates: Table III compares maximum diameters of colonies of _M_. _sulfurea_ tested at five temperatures. Growth occurred at 25 C, albeit slowly, and at 55 C for all isolates tested. The minimum temperature is close to 25 C, the maximum 55-57 C (Cooney and Emerson, 1964). Chapman (1974), studying the effects of temperature on growth rates of several thermophiles, concluded the optimum for _M_. _sulfurea_ was 40-45 C, with no growth at 30 C or 55 C after 8 days.

TABLE III
DIAMETER (MM) OF AGAR PLATE COLONIES OF MALBRANCHEA SULFUREA AFTER GROWTH AT DIFFERENT TEMPERATURES

Temperature (°C)	25[1]	30[1]	37[2]	45[2]	55[2]
Time (days)	28	35	7	7	7
2481	+	75	78	90	N
2485	+	30	73	90	42
2486	+	66	72	90	N
3747	+	23	74	80	26
3748	+	16	77	80	10
3761	N	N	N	N	32
3788	N	N	N	N	42
3789	N	N	N	N	25

Legend:
+ Scant growth (diameter of colony < 5 mm)
N Not tested
1 Growth tested on oatmeal agar only
2 Growth tested on PYE agar

Cellulolytic Activity: M. sulfurea attacks cellophane vigorously, markedly weakening the membrane by 21 days.

Chang (1967) reported growth on xylan, the major hemicellulose of straw, when provided as the sole carbon source, but no utilization of cellulose in the form of filter paper, an observation confirmed by Fergus (1969). Fergus (1969) demonstrated the use of carboxymethyl cellulose. Tansey (1971a) measured the zone of clearing of acid swollen cellulose in an agar medium. Although M. sulfurea produced a definite clearing, indicating cellulolytic activity, the zonal front was indistinct and difficult to measure. Tansey suggested that a portion of the system of enzymes required for digestion of cellulose could be lacking, thereby rendering the organism incapable of attacking insoluble cellulose.

Metabolites: Rode et al. (1947) identified an antibiotic from *M. sulfurea* as comparable in activity to authentic penicillin. Ong and Gaucher (1973), examining a number of thermophiles, characterized intracellular and extracellular proteases, one of which, the extracellular alkaline protease of *M. sulfurea*, has been defined by Voordouw, Gaucher and Roche (1974) as thermomycolase, a thermostable protein protease.

Lipids: Mumma, Fergus and Sekura (1970), studying the lipid composition of some thermophilic and mesophilic fungi, revealed a difference in the degree of saturation of fatty acids, measured by the number of double bonds per mole of fatty acid. The thermophiles, in comparison to mesophiles of the same genus, were found to be more saturated, *i.e.*, have fewer double bonds per mole. Crisan (1973) pointed to the higher melting point of the saturated fatty acids as a factor in the thermostability of these organisms, and discussed lipid stability as one of four hypotheses explaining thermophilism in fungi. However, he considered the best explanation of thermostability resided in the basic ultrastructure of the organism, possibly in the integral genetic make-up, the cell structure or the ribosomes. Mumma *et al.* (1970), finding a higher lipid composition for *M. sulfurea* than some other thermophiles, suggested the difference may be due to extraction of soluble pigment.

Material Examined
UAMH 3761, NEOTYPE, from retting *Parthenium argentatum*, Salinas, Calif., R. Emerson (27), 1945, CMI 126327; From ensiling alfalfa hay forage: UAMH 2481, isol. 1953, rec. from Semeniuk, S. Dakota State Univ., Brookings as 401; UAMH 2485, 1953, from Semeniuk as 422; UAMH 2486, 1953, from Semeniuk as 459; From dung: UAMH 3747, manure in cattle feedlot, Lethbridge, Alta., R.G. Bell, 1974, Research Station, Lethbridge as 1; UAMH 3748, manure in cattle feedlot, Lethbridge, R.G. Bell, 1974, as 2; UAMH 3789, deer dung, Hiroshima, Japan, K. Minoura, 1970, from Tubaki, IFO 9739; From other substrates: UAMH 3827, soil, hen-house litter, A.H.M. Grimbergen, CBS 343.55; UAMH 3857, seed of *Oryza sativa*, China, CBS 115.68; UAMH 3858, CBS 960.72; CBS 423.54

B) *Malbranchea* species with straight fertile hyphae

Malbranchea dendritica Sigler & Carmichael sp. nov.

History

During a search for *Coccidioides immitis* in California soil, Plunkett, Walker and Huppert (1963) isolated three fungi which produced arthroconidia from acutely branched hyphae, giving a "pine-tree appearance" to the sporulation in slide culture. They inoculated three mice intraperitoneally with each strain and killed them after 10, 15 and 20 days. Small nodules were found in all mice, but no endosporulating spherules were seen. "When planted on media, these nodules yielded colonies that were identical to the original culture. Isolates from tissue were prepared for inoculation into a second group of five mice. On the 7th day after inoculation all mice revealed endosporulating spherules at autopsy and established the identification as C. immitis. The cultures recovered from the mice were again identical to the original one." Despite the discrepancy between the results of the first and second sets of mouse inoculations, they identified their isolates as atypical Coccioides immitis.

Huppert, Sun and Bailey (1967) studied a collection of 301 strains of fungi which would grow on media containing cyclohexamide. They stated that for each strain endosporulating spherules had been demonstrated in mice inoculated intraperitoneally, and the fungus recovered in culture. Thus, they identified all their strains as C. immitis, regardless of their colonial and microscopic morphology. Details of the animal inoculations were not given. Some of their isolates (strain numbers not given) had acutely branched fertile hyphae and their Figure 6 shows the microscopic morphology which we now consider to be characteristic of M. dendritica. Their Figure 7 shows a Malbranchea similar to M. gypsea (q.v.). (See also discussion under Malbranchea state of Coccidioides immitis).

Orr (1968) isolated a dendroid Malbranchea from soil. Later (Orr, 1972), he compared the pathogenicity of this isolate (UAMH 2731, DPG-141) with several other isolates of Malbranchea, including strains of M. gypsea, and with Coccidioides immitis. Passage of each organism though mice produced lesions in the spleen and liver but no endosporulating spherules were observed in mice other than the ones inoculated with C. immitis. In addition, histopathological examination revealed no fungal elements, although the arthroaleuriospore-formers could be recovered in culture from the tissue. Malbranchea dendritica was recovered from the lungs in addition to the spleen and liver and survived four serial passages though mice. Control mice inoculated with physiological saline were negative.

It appears probable that the three isolates of Plunkett et al. (1963) and some of the atypical Coccidioides immitis strains of Huppert et al. (1967) should be included in Malbranchea dendritica.

Coloniae in agaro ad 25 C moderatim lente crescunt, cremeofulvae, velutinae. Incrementum lentum ad 37 C.

Hyphae fertiles in angulo acuti ramosae, dendroideae. Arthroconidia cylindrica, non curva, hyalina, laevia, 1.5-2(3) x 3-5um.
Typus: UAMH 2731, ex solo, Dugway, Utah, 1967, G.F. Orr, DPG 141

The colony on PYE (Fig. 16K) is 31 mm diam. in 21 days, creamy buff, reverse buff, rising to a central plateau, velvety. On cereal (Fig. 16L), the colony is 37 mm diam. in 21 days, white, reverse white, slightly raised, scarcely zonate, velvety. At 37 C, the colony on PYE is 23 mm diam. in 21 days, white, heaped up and convoluted, velvety, detaching from the cellophane at periphery; on cereal (diam. as on PYE), flat at periphery, cerebriform in center, waxy, pale buff.

The fertile hypha, branched at an acute angle from the primary hypha (Fig. 16M) is straight, bearing multiple short or long lateral branches. Branching is consistently acute, giving the fertile hypha a tree-like appearance (Fig. 17A). At first, arthroconidia develop apically on the main axis of the fertile hypha and on the lateral branches (Fig. 17B). Later, the base of the hypha and the primary hypha become regularly septate, followed by separation into arthroconidia. Arthroconidia are separated by one or more empty segments, a single segment often shorter than the length of an arthroconidium. Arthroconidia are hyaline, smooth, cylindrical 1.5-2(3) x 3-5um.

The regularly acute angle of branching of the fertile hyphae distinguishes _M. dendritica_ from all other species of _Malbranchea_.

Habitat and activities: Recovered from soil, Utah, cave floor, Malayasia (Emmons, 1967). Moderately keratinolytic, no penetrating bodies.

Material examined: UAMH 2731, TYPE, soil, Dugway, Utah, G.F. Orr, 1967 (DPG 141); UAMH 3953, soil, Dugway, (Orr 0-3230; NRRL 5131; ?same strain as UAMH 2731); UAMH 3956, cave floor, Kuala Lumpur, Malayasia, from Kwon-Chung, N.I.H., Bethesda (B-3056; I-752B)

Malbranchea _flava_ Sigler & Carmichael sp. nov.
?= _Malbranchea_ state of _Oncocladium_ _flavum_ Wallroth 1833, Flor. Crypt. German. p. 289

History

In 1900, A. L. Smith described _Gymnoascus verticillatus_, as having brown, thick-walled verticillately branched peridial hyphae and globose (2.5um diam.) ascospores, occurring separately, or in ascus-like groups.

In 1963, Orr and Kuehn transferred this species to a new genus, Actinodendron, redescribing it from Smith's description and information supplied by Stockdale and Balfour-Browne, who examined Smith's type specimen, HERB BM. Because of its verticillately branched peridial hyphae, the fungus was considered distinct from Gymnoascus Baranetzky. Smith (1900, 1901) apparently did not attempt pure cultures, but Orr and Kuehn (1963) reported several recent isolations of the fungus, by Szathmary in Hungary, Plunkett in California, and Stockdale in Wales. However, the verticillately branched hyphae observed in the original specimens could not be reproduced in culture. Also, neither asci nor ascospores were observed in the specimens of Szathmary and Plunkett. Several fungi were isolated from Plunkett's hair bait sample (all designated OAP- 19-317), two of which had arthroaleuriospore states. Orr and Kuehn (1963) suggested that a keratin source such as hair may be required for gymnothecial development.

Apinis (1964) examined several specimens of Actinodendron verticillatum, including Smith's type material, Stockdale's specimen from sheep's wool (HERB IMI 100,300), his own isolate from a dead bird, and one from feathers placed in a damp chamber (HERB K). In the latter material, Apinis observed asci and ascospores as well as the characteristic appendages in older brown clusters formed on the feathers. In addition, he reported aleurioconidia resembling those of Chrysosporium merdarium, arthroconidia resembling those of Geotrichum, and endogenous microconidia. Apparently, Apinis did not attempt to make pure cultures from the feathers.

Hughes (1968), comparing the type specimen of Oncocladium flavum Wallroth, a Hyphomycete, with the type specimen, HERB BM, of Actinodendron verticillatum, concluded that the verticillately branched hyphae in both were identical. In the specimen of O. flavum, Hughes observed neither asci nor ascospores, nor any conidia of the Chrysosporium type, but reported an arthroconidial state resembling Oidiodendron. Hughes considered the verticillately branched hyphae to be characteristic of Oncocladium. Since Wallroth's original description did not refer to ascospores, Hughes suggested Oncocladium flavum may be the conidial state of Actinodendron verticillatum. He also noted that Oncocladium could be an earlier name for Oidiodendron.

The taxonomic position of Actinodendron verticillatum was complicated by Orr and Kuehn (1971), who agreed with Hughes, and rejected their own transfer of the fungus to a perfect state genus, since ascospores had not been observed in any but Smith's type specimen. They concluded that the ascospores present in Smith's type material were not part of the same fungus. Apparently, they failed to examine the two specimens reported by Apinis (1964) to have ascospores.

From these conflicting reports, it is difficult to assess the true nature of Oncocladium. On the one hand, there is Apinis' observation of ascospores and on the other, there is Orr and Kuehn's (1971) rejection of Actinodendron. While both Orr and Kuehn (1963) and Szathmary (1967b) reported verticillately branched hyphae in keratin-baited samples, to our knowledge, neither has induced their formation in culture. However, the list of cultures of Oncocladium flavum examined by Orr and Kuehn (1971) includes isolates from Plunkett's hair bait sample (OAP-19-317, incorrectly cited as OAP-19-1317) (Orr and Kuehn, 1963), as well as several arthroaleuriospore-formers corresponding in appearance to isolates described as Gymnoascus verticillatus by Szathmary (1967a,b).

In specimens we have examined, HERB IMI 100,300 of Stockdale, and HERB IMI 100,445, a few spiny, oblate ascospores were observed in the latter. The label on the specimen indicated Anixiopsis stercoraria [= Aphanoascus fulvescens] to be present. Conidia of the Chrysosporium type and the appearance of the ascospores agree with A. stercoraria, although no cleistothecia were observed. In any case, the ascospore appearance does not agree with the descriptions of Smith (1900) and Apinis (1964). No ascospores were observed in two slides of IMI 100,300.

In both specimens, however, an arthroconidial state is present within clusters bearing verticillately branched hyphae (Figs. 17C,17D). Pseudogymnothecia or peridial appendages have been observed in culture in some heterothallic Gymnoascaceae, notably Ctenomyces serratus (Benjamin, 1956), Uncinocarpus reesii, and some Myxotrichum and Arthroderma species (Varsavsky and Ajello, 1964; Padhye and Carmichael, 1973; Sekhon, Padhye and Carmichael, 1973). The peridial hyphae of the pseudogymnothecium resemble those of the fertile gymnothecium, but the structure contains only conidia. The presence of infertile gymnothecia confused the taxonomy of Ctenomyces serratus Eidam until Benjamin (1956) showed that Eidam's specimen actually contained two different fungi. Eidam had originally described Ctenomyces as having two stages, a fertile gymnothecial state and a sclerotial or resting state. Although no ascospores were reported by Eidam for the sclerotial state, Benjamin (1956) retained the name Ctenomyces serratus for the fungus distinguished by the characteristic comb-like appendages.

The infrequent occurrence of ascospores in Oncocladium suggests that the fungus may be heterothallic. It seems probable that the verticillately branched hyphae arise as thick-walled extensions of the vegetative hyphae, forming clusters on the natural substrate, but remaining infertile unless compatible mating types are present. In the *Malbranchea* state of *Uncinocarpus reesii*, uncinate appendages occur in the conidial state as extensions of the vegetative hyphae, but only intertwine to form a gymnothecium when compatible strains are mated.

The verticillately branched hypha of *Oncocladium flavum* is narrow at the base, becoming wider at the apical or distal end, terminating in a blunt tip and occasionally extending into a hyaline, septate hyphal appendage, which gradually narrows to a diameter of 2-3um (Fig. 17C). The branchlets forming the verticils are pointed at first, becoming blunt-tipped as the apical segment detaches. In this respect, the hyphae resemble the peridial hyphae of some *Myxotrichum* species which often terminate in blunt spines, the terminal portion having broken off.

We have not yet been able to determine the true nature of the association of the appendages with the arthroconidial state. It appears probable to us that the verticillately branched hyphae are peridial appendages. If so, the name *Oncocladium* could be retained for the sexual state since the key feature of *Oncocladium*, as Hughes (1968) noted, is the verticillately branched hyphae. The arthroconidial state, clearly distinct from *Oidiodendron* is assigned to *Malbranchea*.

Coloniae in agaro ad 20-25 C moderatim rapide crescunt, sulphureae, citreae vel alboluteae, pulveraceae vel floccosae, densae, siccae, planae vel undatae, rimosae. Incremuntum paulum ad 30 C, nullum ad 37 C. Arthroconidia cylindrica, directa, laevia, hyalina, posteriorus chlorina, 2-3 x 2-6um, plerumque 2-3 x 2.5-5.5um.
Typus: UAMH 1589, ex solo, California, 1962, O.A. Plunkett, OAP 19-317

Colonies on PYE (Fig. 17F) are 39-61 mm diam. in 21 days, lemon-yellow with darker gold center, sulfur-yellow, greenish-yellow, rarely creamy white. The surface is powdery, rarely woolly, dense, dry, separating from the cellophane and lifting in the center, undulate, often cracked or split with folds extending to the margin, scarcely zonate (Fig. 17E). Growth on cereal (Fig. 17G) is 26-39 mm diam. in 21 days, flat, straw-yellow, with darker gold center, rarely white, coarse, powdery or woolly, with scant diffusing yellow pigment. In some strains, a wrinkled, waxy small umbo with tiny cracked furrows, develops at center. The optimum temperature is 18-25 C; 30 C is close to the maximum. One strain (UAMH 1879) showed scant growth at 5 weeks (10 mm).

Arthroconidia developing on straight, branched fertile hyphae (Figs. 17H-17J), separated from each other by one or more empty segments (Fig. 17H), are divided by

Habitat and activities: Recorded from soil, California, Hungary and France (Szathmary, 1967a,b; Orr and Kuehn, 1963, 1971). Most isolates were only slightly keratinolytic. Two strains (UAMH 1879 and 1956) did not attack hair at all. This limited capacity to digest hair *in vitro* is interesting since most isolations were made from keratin-bait techniques. In addition, it has been suggested that development of gymnothecia of *Actinodendron verticillatum* may depend upon a source of keratin (Orr and Kuehn, 1963).

Material Examined
Soil isolates from Orr: UAMH 1589, TYPE, Calif., O.A. Plunkett, 1962, (OAP-19-317); UAMH 1879, Calif., O.A. Plunkett, (OAP-19-317(6)); UAMH 1956, Arg., E. Varsavsky, (EV 5V;0-3596); UAMH 2859, Tunis, C. De Vroey, (RV 19535a; 0-3496); UAMH 2860, sector of RV 19535a, G.F. Orr, (RV 19535b); UAMH 2864, fabric-bait, Hungary, Szathmary, 1967, (0-3512); UAMH 2865, fabric-bait, Hungary, Szathmary, 1967, (0-3514); Material of *Oncocladium flavum*: HERB IMI 100,300, sheep's wool on dung, Wales, P.M. Stockdale, 1962 (UAMH 3920); HERB IMI 100,445, wool, associated with *Anixiopsis stercoraria* (UAMH 3921)

Malbranchea flocciformis Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25 C moderatim lente crescunt, tangerinae vel flava, cumulae, convolutae, lanuginosae vel velutinae. Incrementum nullum vel exiguum ad 37 C. Arthroconidia cylindrica, directa, in fascicula densa, hyalina vel lutea, laevia, (1.5)2-2.5 x 2-5.5um.
Typus: UAMH 3273, ex solo salino, Chateau-Saline, Lorraine, France

Colonies on PYE (Fig. 18A) are 22-42 mm diam. in 21 days, adhering poorly to the cellophane, lifting at margin,

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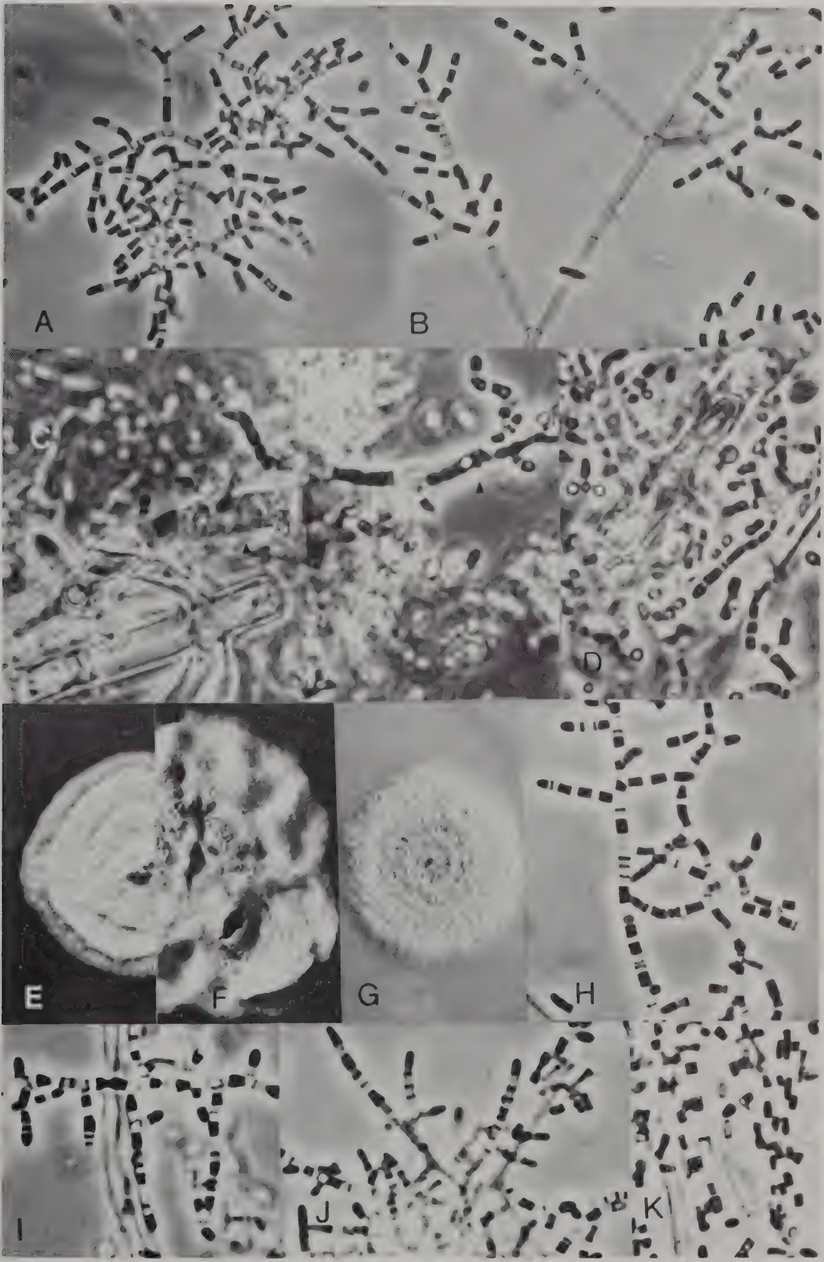
Figure 17. A-B. *Malbranchea dendritica* (UAMH 2731). C-D. *Oncocladium flavum* (IMI 100300). F-K. *Malbranchea flava* (E,J,K-2864; F,G-1589; H-1956; I-1879). Figs. 17A-17B. Tree-like appearance of branched fertile hypha. Fig. 17C. Blunt tipped verticillately branched hypha with hyaline terminal appendage (arrows). Fig. 17D. Verticillately branched appendage and associated arthroconidial state. Figs. 17E-17G. Colonial morphology at 25 C. E and F on PYE, G on cereal. E at 14 days, F and G at 21 days. Figs. 17H-17J. Alternate arthroconidia of branched fertile hyphae. Fig. 17K. Arthroconidia with refractile end walls. Colonies x 0.7, others x 600.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or at center with margin depressing the medium. Colonies are domed with deep folds or convolutions, or petaloid, pale or tangerine orange, reverse tan, downy or velvety, sometimes with exudate droplets at center. On cereal agar, colonies (Fig. 18B) are flatter (24-38 mm diam. in 21 days), either downy, dome-shaped with margin depressing the medium, or crateriform, zonate and powdery, pale or tangerine orange or pale yellow. One strain (UAMH 675) formed yellow exudate droplets and brown diffusing pigment. No growth at 37 C, except scant growth by UAMH 3273 (5 mm in 21 days on PYE).

Arthroconidia are borne on the primary hyphae (Fig. 18C) and on short or long lateral branches (Figs. 18C,18D) which often branch repeatedly to form a dense tuft (Fig. 18E) The fertile hyphae are characteristically straight, occasionally curved (Fig. 18F). Arthroconidia are cylindrical, hyaline or pale yellow, orange in mass, smooth (1.5) 2-2.5 x 2-5.5um.

_M_. _flocciformis_ digests cellophane after prolonged growth and is slightly keratinolytic.

Discussion

Two of the strains included here were initially determined to be _M_. _pulchella_. Of the two, UAMH 675 resembles _M_. _pulchella_ in its curved fertile hyphae (Fig. 18F) but differs in forming accessory arthroconidia on the primary hyphae and in having orange colonies. Although UAMH 675 may not be suitably placed in this species, it is retained here until further isolates have been examined.

Material Examined

UAMH 675, wooden lemon storage bin, Calif., P.R. Harding, 1959, ex DAOM 64000 (CMI 96741); UAMH 3273, TYPE, briny soil, Chateau-Saline, Lorraine, France, from J. Nicot, Laboratoire de Guffbogaurie, Paris; UAMH 3785, salty soil, France, J. Villoutreix, CBS 361.69

Malbranchea _fulva_ Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25-30 C moderatim rapide crescunt, cum zonis concentricis, alataceae vel brunneae vel flavae, pulveraceae vel granulatae. Incrementum nullum vel paulum ad 37 C.
Arthroconidia cylindrica vel doliformia, subflava, laevia, 2-3(3.5) x 3.5-8(11)um.
Typus: UAMH 2851, ex aere, Dugway, Utah, 1967, G.F. Orr, O-3042 (DPG 167; NRRL 5160)

Colonies on PYE (Fig. 18G) are 38-44 mm diam. in 21 days, powdery, occasionally downy at center. The surface is zonate, slightly raised with central tan or yellow umbo, tan or pale brown or yellow near center, and white or hyaline at periphery, reverse dark tan or reddish-brown with diffusing tan pigment. The zonate pattern is more distinct on half of the colony, with umbo often positioned slightly off center. On cereal agar (Fig. 18H), colonies (diam. as on PYE) are flatter, with a small ridge surrounding a zone of less dense aerial growth at center, tan or buff-brown, reverse tan, powdery or granular, with diffusing tan or brown pigment. Optimum range 25-30 C; growth at 37 C variable (scant growth by some strains, 2-8 mm in 21 days).

Hyphae bearing arthroconidia are straight, branched (Figs. 18I,18J), septate, 2-4um wide. Racket hyphae appear during early growth, swelling to 5-6um in diameter. Septa formed in the fertile hyphae are thick (Figs. 18I,18J) suggesting double septa, and at maturity arthroconidia develop refractile terminal walls (Fig. 18K). Arthroconidia are cylindrical or barrel-shaped, hyaline, pale yellow, in mass yellow, smooth, 2-3(3.5) x 3.5-8(11)um, sometimes remaining connected in pairs. Orange-brown slime occasionally surrounds some hyphae (Fig. 18L). No other spore state was observed and an attempt to cross the isolates was unsuccessful.

Discussion

M. fulva lacks the uncinate appendages of the *Malbranchea* state of *Uncinocarpus reesii* and has slower growing tan colonies and restricted growth at 37 C. *M. fulva* lacks the arcuate fertile hyphae of *M. arcuata*.

Habitat and activities: Recovered from air (Orr and Kuehn, 1972), soil and dung, California, Utah and Colorado. Strongly keratinolytic, producing marked digestion of hairs with penetration of hair by single hyphae; not cellulolytic.

Material Examined

From soil: UAMH 1050, Riverside Co., Calif., G.F. Orr, (0-759); UAMH 1708, Palo Verde, Calif., G.F. Orr, 1957, (0-630); From air sample: UAMH 2849, wind tunnel contaminant, Utah, G.F. Orr, 1967, (4TL3); UAMH 2851, TYPE, Dugway, Utah, G.F. Orr, 1967, (DPG-167; 0-3042; NRRL 5160); From dung: UAMH 3889, mouse, Fruita, Color., (Orr 0-1508); UAMH 3901, lizard, Palo Verde, Calif., (Orr 0-1319); From unknown source: UAMH 3729, (Orr DPG-45).

Malbranchea gypsea Sigler & Carmichael sp. nov.

Coloniae in agaro ad 25-30 C lente vel moderatim crescunt, gypseae vel cremeae, cumulae, convolutae, velutinae vel floccosae. Incrementum nullum vel paulum ad 37 C.

SEE ERRATA

Arthroconidia cylindrica vel subdoliformia, hyalina, laevia, 2-2.5 x (2.5)3-6(9)um.
Typus: UAMH 1975, ex solo, Bakersfield, California, 1964, G.F. Orr, 0-2565

Growth on PYE variable, 17-39 mm diam. in 21 days, mostly 27-30 mm diam. Colonies (Fig. 19A) are chalky-white or creamy white, reverse buff, downy or velvety, slightly raised, domed with folded or convoluted surface, sometimes with prominent central umbo. The colony (Fig. 19B) of two strains (UAMH 1942 and 1943) was smoother with hairy or coarsely woolly matted texture and glabrous margin. On cereal, colonies (Fig. 19C) are 15-42 mm diam. in 21 days (mostly 27-32 mm), white, reverse white or tan, powdery, downy, or floccose, almost flat or domed with small central umbo and small irregular folds. One strain (UAMH 1975) excreted tan pigment by 21 days. Optimum range 25-30 C; growth at 37 C variable (scant growth by UAMH 1941 and 1943). One strain (UAMH 1734) grew poorly at 30 C.

Arthroconidia (Figs. 19D,19F), borne in an intercalary or terminal position on the straight primary hyphae or on short or long lateral branches, are separated by one or more alternate empty cells, or rarely, formed immediately adjacent to each other (Fig. 19E). Arthroconidia are cylindrical or slightly barrel-shaped, slightly broader than the width of the interconnecting hypha (Figs. 19E,19F), hyaline, smooth, 2-2.5 x (2.5)3-6(9)um. No other spore state was observed. An attempt to cross three isolates (UAMH 1841, 1943 and 1975) with each other was unsuccessful.

Discussion

The white colonies and lack of arcuate fertile hyphae distinguish *M. gypsea* from most other species of *Malbranchea*. During early development, *M. gypsea* may be confused with the *Malbranchea* state of *Uncinocarpus reesii*,

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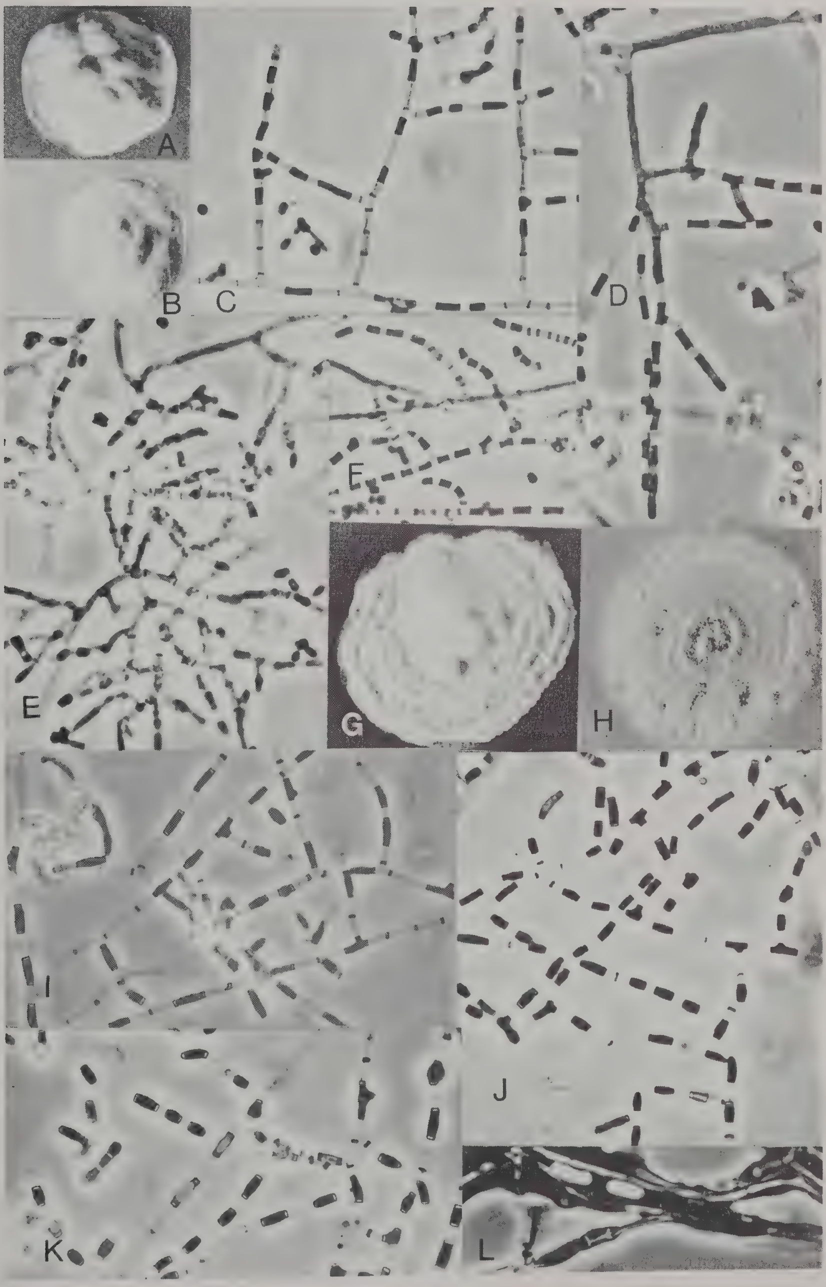
Figure 18. A-F. *Malbranchea flocciformis* (A-E-3273; F-675). G-L. *Malbranchea fulva* (G,H-2851; I-1708; J-2849; K,L-3729). Figs. 18A-18B. Colonial morphology after 21 days at 25 C. A on PYE, B on cereal. Figs. 18C-18D. Alternate arthroconidia borne on straight primary hyphae and lateral branches. Fig. 18E. Repeated branching of fertile hyphae. Fig. 18F. Slightly curved conidiogenous branches. Figs. 18G-18H. Colonial morphology at 21 days at 25 C. G on PYE, H on cereal. Figs. 18I-18J. Intercalary arthroconidia of straight, branched fertile hypha. Fig. 18K. Mature arthroconidia with refractile terminal walls. Fig. 18L. Orange-brown slime surrounding vegetative hyphae. Colonies x 0.7, others x 600.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especially if the characteristic uncinate appendages of the latter are lacking. However, the *M.* state of *U. reesii* differs in forming arthroconidia which are slightly broader, 2.5-3um in diameter compared to 2-2.5um for *M. gypsea*; in growing more vigorously at both 25 C and 37 C; and in being markedly keratinolytic in contrast to *M. gypsea* which is cellulolytic.

Habitat and activities: Can be recovered from lesions on the spleen and liver after passage through experimental animals (Orr, 1972). (See discussion under *Malbranchea* state of *Coccidioides immitis*). Cellulolytic after prolonged growth; not keratinolytic.

Material Examined
Isolates from soil passaged through experimental animals (from Orr): UAMH 1941, Calif., Huppert (SFVH 129), (Orr 0-3226); UAMH 1942, Calif., Huppert (SFVH 130), (Orr 0-3283); UAMH 1943, Calif., Huppert (SFVH 149), (Orr ?0-1088); From other substrates: UAMH 1734, cat hair, C.W. Emmons, (Orr 'cat hair PBSF'); UAMH 1975, TYPE, soil, Bakersfield, Calif., G.F. Orr, 1964, (VJC 4; 0-2565)

Malbranchea state of *Coccidioides immitis* Stiles
in Rixford & Gilchrist 1996, Johns Hopkins Hospital Report
1:209-269

The cultural morphology and pathology of *C. immitis* are described in medical mycology textbooks (see Rippon, 1974). Since Alberta is not an endemic zone, the following description is based on two locally isolated strains (UAMH 3624 and 3667) from infected travellers. Slide cultures of these strains were kindly supplied by Dr. A. S. Sekhon (Provincial Laboratory of Public Health, Edmonton).

The arthroconidia are borne in an intercalary or terminal position on short or long, straight, lateral branches, arising at right angles from the vegetative hypha (Fig. 19G). The vegetative hyphae are narrower than the fertile branches, septate, hyaline, 2-4.5um wide, often swelling at the septa to 9um, and do not divide into arthroconidia. Arthroconidia (Figs. 19H,19I) are closely spaced, separated by short segments, hyaline, barrel-

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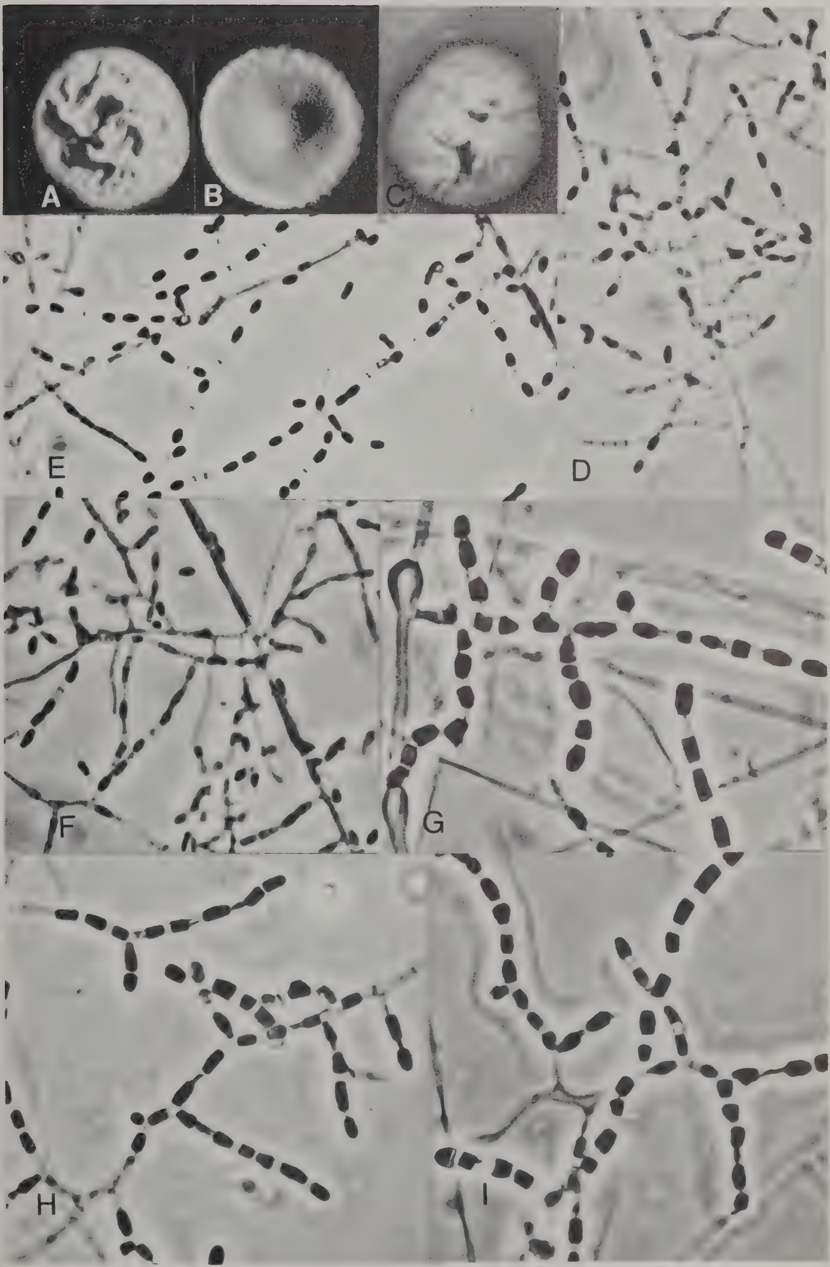
Figure 19. A-F. *Malbranchea gypsea* (A,C-UAMH 1975; B-1843; D-F-1841). G-I. *Malbranchea* state of *Coccidioides immitis* (3624). Figs. 19A-19C. Colonial morphology after 21 days at 25 C. A and B on PYE, C on cereal. Figs. 19D-19F. Arthroconidia borne on primary hyphae and straight lateral branches. Figs. 19G-19I. Closely spaced, barrel-shaped arthroconidia borne on straight lateral branches. Colonies x 0.7, others x 600.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shaped, cuneiform if terminal, 3-5(6) x 3-8um, mostly 3.5-4.5 x 3-8um. In width, arthroconidia are the same or only slightly larger than the width of the fertile hypha.

Discussion

In its arthroconidium formation, *C. immitis* is close to the borderline between *Malbranchea* (conidia mostly less than 4um in diameter) and *Sporendonema* (conidia mostly more than 4um in diameter). However, the general appearance of the fertile hyphae and arthroconidia most closely resembles the other species of *Malbranchea*. Indeed, Huppert *et al.* (1967) apparently confused some isolates of other *Malbranchea* species with *C. immitis* and described them as variants of *C. immitis*. They reported that these unusual isolates produced coccidioidomycosis in mice, but made no mention of controls to rule out the possibility of accidental infection of their mice with *C. immitis*. Their figure 6 displays the distinctive arthroconidial morphology of *Malbranchea dendritica*. The type strain of *M. dendritica* (UAMH 2731) studied by Orr (1972) survived for long periods in mice and could be recovered from the spleen, liver and lung. However, no endosporulating spherules or other fungal elements were found in any tissue by Orr.

In the same study, Orr (1972) included three other arthroaleuriospore-forming isolates (UAMH 1941, SFVH 129; UAMH 1942, SFVH 130; UAMH 1943, SFVH 149), none of which produced coccidioidomycosis in mice. These three strains, which have been included in the species *Malbranchea gypsea*, are not so distinctive in their microscopic morphology. However, Figure 7 of Huppert *et al.* (1967) suggests *M. gypsea* and may be a photomicrograph of one of the above strains having SFVH numbers.

Three isolates were received from the CDC as *C. immitis* from Russia (UAMH 3595, 40-73-48553; UAMH 3596, 40-73-48555; UAMH 3602, 40-73-48554). They form chains of budding conidia and have been assigned to the form-genus *Fusidium* (Lechevalier, Lechevalier, Handley, Ghosh and Carmichael, 1976).

The arthroconidia of the *Malbranchea* state of *C. immitis* are broader than all other species of *Malbranchea* which are mostly less than 4um in diameter. Arthroconidia of *M. sulfurea* measure 2.5-4um but this species is thermophilic and forms arcuate fertile hyphae. The arthroconidia of the *Malbranchea* state of *U. reesii* are slightly narrower, 2.5-3.5um occasionally 4um in diameter and are separated by intervals of irregular length. In addition, this species regularly forms uncinate appendages in culture.

Malbranchea state of Uncinocarpus reesii
Sigler & Orr sp. nov.

Perfect State: Uncinocarpus Sigler & Orr gen. nov.

Ascomycotina, Gymnoascaceae. Gymnothecia eperidiata. Asci inter appendices. Appendices laeves, aseptatae, brunneae, intertextae, uncinatae. Asci subglobosi, evanescens, octospori. Ascosporae oblatae, laeves, flavo-brunneae vel rufo-brunneae.
Typus: Uncinocarpus reesii Sigler et Orr sp. nov.

Gymnothecia more or less spherical, reddish brown. Ascomatal initials on short stalks, bulbous. Peridial hyphae, smooth, aseptate, consisting of elongate appendages loosely intertwined. Free ends extending beyond the core of the ascocarp, uncinate, sometimes spiral. Asci subglobose, evanescent, 8-spored. Ascospores oblate, smooth, yellow to reddish-brown. Malbranchea conidial state.

History

This fungus has been frequently isolated during surveys of soil and keratinous substrates. The conidial state, most often encountered, has been ascribed to Chrysosporium, Malbranchea or various conidial forms of Gymnoascaceae. The perfect state has been reported by various workers as a probable new genus of the Gymnoascaceae, but not given a name (see below).

Attention focused on the conidial state because of its resemblance to the pathogenic Coccidioides immitis. Emmons (1954) studied several Gymnoascaceae isolated from organs of rodents and other animals. Some of these, which he called Myxotrichum, formed the sexual state, whereas others, seemingly degenerate, produced only peridial appendages. The loss of fertility appeared to be related to a change in colony color from orange to white.

Examining two of Emmons' ascosporic isolates, Kuehn (1955a) described Myxotrichum emmonsii, later reduced to synonymy with Auxarthron umbrinum (Boudier) by Orr & Plunkett (in Orr et al., 1963a). Both Kuehn, and Orr and Plunkett described an arthroconidial state, though neither reported the persistence of peridial appendages in degenerate strains.

However, Kuehn et al. (1964) reported persistence of appendages but no ascocarps in isolates believed to be similar to Auxarthron brunneum. In a later report, Emmons (1967) confirmed that his ascocarpic isolates earlier designated Myxotrichum were M. emmonsii Kuehn and again reiterated his observations of peridial appendages persisting in infertile strains. Emmons discerned little difference between Auxarthron umbrinum and A. brunneum and noted that arthroconidia of both resembled Coccidioides immitis. Furthermore, he found no evidence to suggest that appendages persisted in any other Gymnoascaceae maintained in culture.

Rees (1967a), surveying keratinophilic fungi from Australia isolated the conidial state of "? Gymnoascus uncinatus" from Rattus rattus. Later, he (1967b) isolated "Genus A" and noted its similarity to the previously reported "? G. uncinatus" which formed only arthroconidia and trichomes in culture. He concluded that the relationship of "Genus A" and "? G. uncinatus" to Gymnoascus uncinatus appeared doubtful. The type specimen of U. reesii was derived from one of Rees' strains (F143).

De Vroey (1970) reported the fungus from soil in Sulawesi, Celebes Islands. Caretta and Piontelli (1975) illustrated the conidia and appendages of a strain they isolated from soil in Italy. Hubalek (1974a) reported several isolates of the conidial state as a probable new species of Auxarthron from birds in Yugoslavia and Czechoslovakia.

Uncinocarpus reesii Sigler & Orr sp. nov.

Heterothallicus. Gymnothecia, et cetera in modo generis. Ascosporae 2.5-3 x 4-5um, plerumque 2.5-2.8 x 4-4.5um. Coloniae in agaro ad 25-30 C moderatim rapide crescunt, cremeae, vel fulva, numquam aurantiae, cumulae, convolutae, rimosae, lanuginosae vel pulveraceae. Incrementum tardum ad 37 C.
Arthroconidia (Malbranchea) copiosa, cylindrica vel doliformia, hyalina, posteriorus fulva, laevia, 2-4 x 3-6(8)um, plerumque 2.5-3.5 x 3.5-6um.
Typus: UAMH 3882, ex cruce UAMH 3880 x UAMH 3881.
Hi ex UAMH 2845 lecto.
UAMH 2845, ex pennis, Australia, 1967, Rees, F.143

Colonies on PYE (Fig. 20A) are 51-64 mm diam. in 21 days, creamy white or buff, never orange, reverse dirty yellow, domed and convoluted, or flatter with outward radiating folds, sometimes umbonate, downy or powdery. If powdery, cracks appear near center and along folds. At 37 C, colonies grow slowly (6-24 mm diam. at 21 days), adhering poorly to the cellophane, heaped up, convoluted, downy, waxy or glabrous, or grow more rapidly (Fig. 20B) (28-46 mm diam. at 21 days) slightly raised, with numerous folds, downy, white or tan, with dark brown exudate droplets, and yellow diffusing pigment. This pigment can be detected only with difficulty in some strains at 25 C, since it is usually obscured by the yellow color of the PYE.

Colonies on cereal (Fig. 20C) are 39-53 mm diam. in 21 days, creamy white, buff or tan, never orange, white periphery, reverse the same. The surface is powdery or granular, rarely downy, dense or patchy, appearing mottled, occasionally zonate, flat with small central umbo and numerous tiny cracks or fissures. At 37 C, growth at 21 days is scant (5-10 mm) or restricted (14-26 mm). Colonies of the latter (Fig. 20D) are downy, floccose and white, or tan and granular, with a brown diffusing pigment (Fig. 20D). This brown pigment is difficult to detect at 25 C.

Heterothallic. Gymnothecia (Figs. 20E,20H) discrete, reddish-brown, globose, compacted in the center, 200-1000um, with appendages extending beyond 100-250um. Ascomatal initials, hyaline, arising as short branches, septate at first, with a bulbous enlarged tip, often completely inrolled (Figs. 20F,20G). Gymnothecium composed of a loose association of intertwined appendages, uncinate at each end, often forming one or more lateral uncinate branches (Fig. 20I), smooth, thick-walled, aseptate, reddish-brown. Appendages mostly uncinate, occasionally spiral, wide at the tip, 5-8um, narrowing at center. No differentiated peridial hyphae but immature gymnothecia often surrounded by a loose weft of hyaline hyphae bearing arthroconidia. Asci evanescent, hyaline, on short stalks, subglobose, 7-9um in diameter (Figs. 20J,20K), 8-spored. Ascospores yellow-brown, reddish-brown in mass, smooth, oblate, sometimes with depression in one face (Figs. 21A,21B), 2.5-3 x 4-5um, mostly 2.5-2.8 x 4-4.5um.

Arthroconidia (Figs. 21D,21E), borne in an intercalary position along the broader (2-5um) primary hyphae, or intercalarly or terminally on short or long lateral branches, are cylindrical, sometimes barrel-shaped or cuneiform if terminal (Figs. 21F,21I). Separated by one or more segments of irregular length, arthroconidia are hyaline, later tan, smooth, 2-4 x 3-6(8)um, mostly 2.5-3.5 x 3.5-6um. Enlarged subglobose or broadly barrel-shaped arthroconidia (Fig. 21C), found in old cultures and near fertile gymnothecia, are 5-8um wide, hyaline, mostly single-celled. Racket hyphae sometimes present.

Characteristic uncinate appendages (Fig. 21G) of the conidial state appear after 7-14 days. The appendage, arising mostly as a thick-walled, more dense extension from the primary hypha (Fig. 21H), or from a thick-walled segment of the hypha resembling a foot cell, becomes uncinate at each end, often forming one or more lateral branches (Fig. 21J). The hypha bearing appendages continues to extend forming arthroconidia along its length. Appendages are uncinate, occasionally spiral, aseptate, pale brown, paler and slightly narrower (3-5um at the tip) than the appendages forming the gymnothecium.

Holotype: UAMH 3882, dried colonies of cross of single
    ascospore isolates UAMH 3880x3881
Mating types: UAMH 3880 '-', single ascospore isolate 'A'
    of UAMH 2845
  UAMH 3881 '+', single ascospore isolate 'E'
    of UAMH 2845

Discussion

The *Malbranchea* state of *Uncinocarpus reesii* is easily identified by its uncinate appendages. These appendages have not been seen in any other conidial state of Gymnoascaceae examined by us. Some strains lack appendages (UAMH 3257 and 3258), but nevertheless can be recognized by their arthroconidia and white or buff colonies. *M. arcuata* differs in forming arcuate fertile hyphae. *M. fulva* grows more slowly at both 25 C and 37 C; its arthroconidia are slightly narrower and often have refractile ends; and arthroconidia are separated by shorter segments, equivalent to or less than the length of an arthroconidium, compared to the intervals between arthroconidia in *U. reesii* which are longer and more irregular.

The genera of Gymnoascaceae are differentiated by the peridial hyphae, the shape and surface ornamentation of the ascospores and the ascomatal initials (Samson, 1972). On this basis, *Uncinocarpus* is similar to *Gymnoascus* Baranetzky, which also has oblate, smooth ascospores. *Gymnoascus* differs in the net-like structure of its peridial hyphae, in its ascomatal initials which are coiled, and in its *Chrysosporium* conidial state (Orr *et al*., 1963c; Samson, 1972). The peridial hyphae and reticulate or spiny, globose or oblate ascospores distinguish the genus *Auxarthron*. *Auxarthron* is similar to *Uncinocarpus* in its keratinolytic activity, its formation of elongate uncinate appendages, and its *Malbranchea* conidial states. *Petalosporus* (Ghosh, Orr and Kuehn, 1963) and *Shanorella* (Benjamin, 1956), two closely related genera, also form

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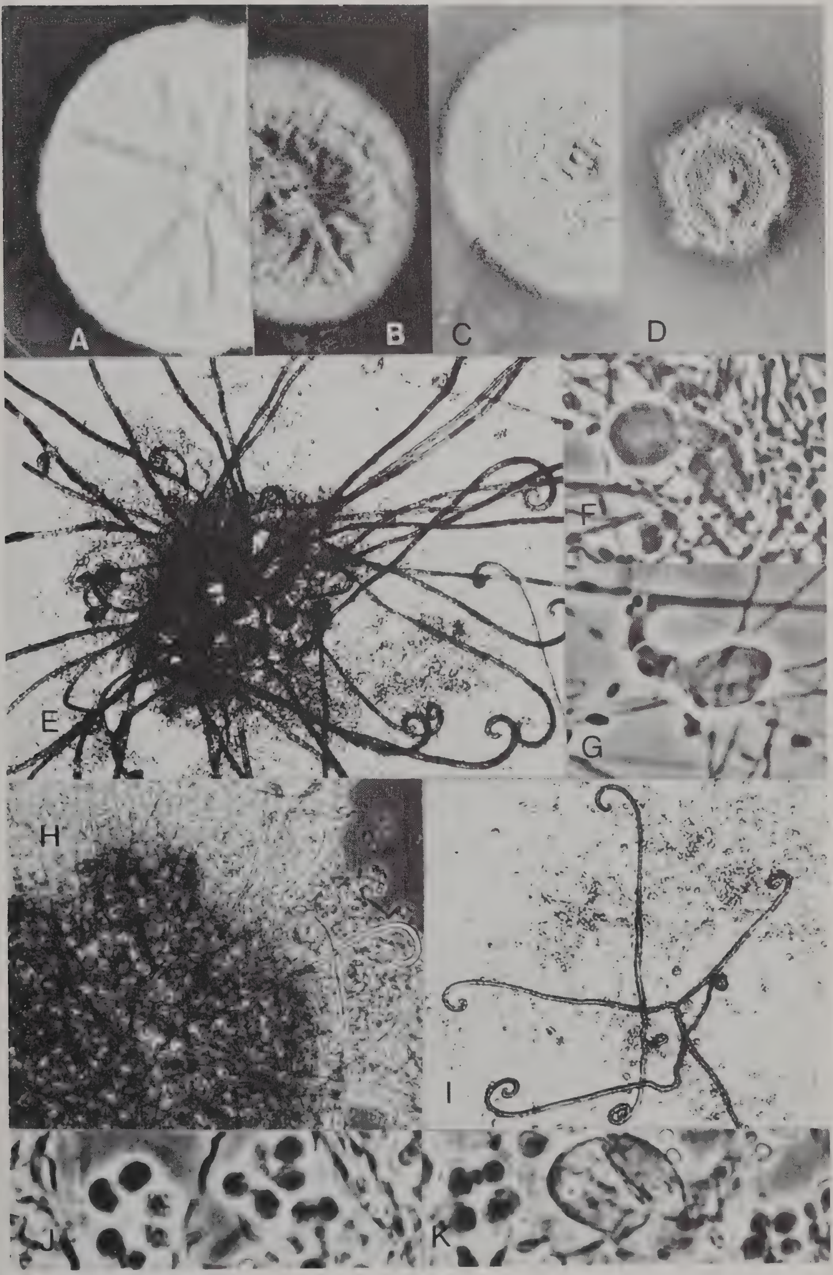
Figure 20. *Uncinocarpus reesii* (A-D-2847; E-2002x2847; F-3484; G-3573; H-2845; I-2855x3257; J,K-3881x2002). Figs. 20A-20D. Colonial morphology after 21 days, x 0.7. A and B on PYE, C and D on cereal. B and D at 37 C, others at 25 C. Fig. 20E. Fertile gymnothecium composed of loose association of uncinate appendages. x 150 BF. Figs. 20F-20G. Ascomatal initials, x 600. Fig. 20H. Gymnothecium, x 150. Fig. 20I. Intertwined branched uncinate appendages from a fertile gymnothecium, x 150 BF. Fig. 20J. Asci, x 600. Fig. 20K. Asci and ascomatal initial, x 600.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oblate ascospores, but differ from Uncinocarpus in their rudimentary peridial hyphae and coiled ascomatal initials. In addition, species of both genera are cellulolytic.

Furthermore, although heterothallic species are common in Nannizzia, Arthroderma and Ctenomyces, none has been reported so far in the other genera of Gymnoascaceae. However, there are several reports of loss of fertility in some species (Orr et al., 1963b; Apinis, 1964; von Arx, 1971; Samson, 1972). The Myxotrichum states of Malbranchea flavorosea and M. circinata reported herein lacked ascospores, suggesting possible heterothallism.

Pathogenicity: Though the pathogenicity of U. reesii has not been firmly established, it appears to be a transient inhabitant of man and animals, and can survive for extended periods in tissue. Emmons (1954) recovered the organism from organs of rodents and other animals and from small omental abscesses at the site of intraperitoneal inoculation into mice.

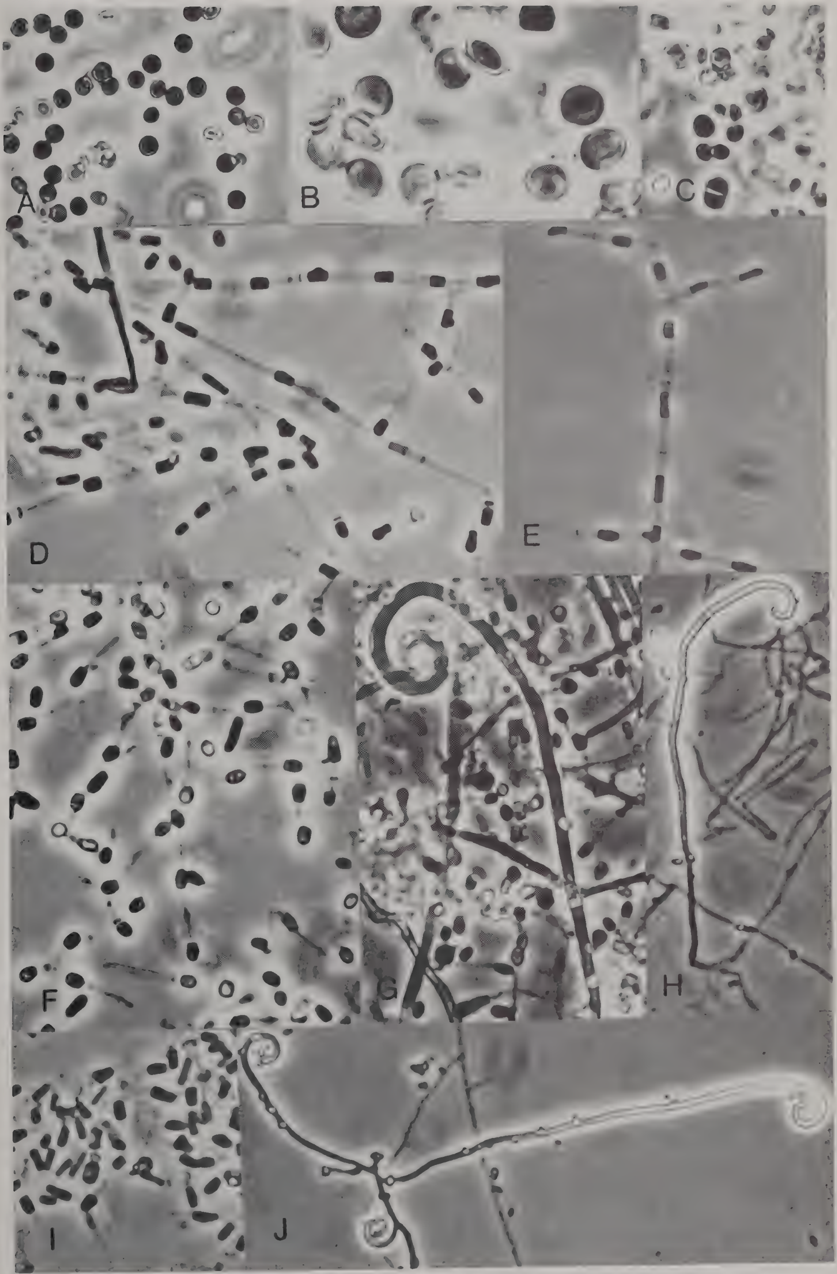
Species of Malbranchea considered to resemble C. immitis have been recovered from animal tissues, human sources and the spleen and liver of mice after intraperitoneal inoculation (Kuehn et al., 1964; Emmons, 1967; Orr, 1968, 1970). Orr (1972) reported that species of Malbranchea could be recovered from tissues of mice even when no gross lesions were apparent, and that fungal elements were not observed in any lesion.

Habitat and activities: Recorded worldwide from soil of desert and wooded area, bat guano, keratinous substrates such as feathers of wild birds and domestic fowl, organs of rodents and human sources. Strongly keratinolytic, digesting hair with the aid of penetrating bodies; not cellulolytic.

Results of Mating Tests

A. Notes on techniques

Figure 21. Uncinocarpus reesii (A-C-1704x2050; D-2845; E-2991; F-3257; G-1704; H-3485; I-3703; J-2847). Figs. 21A-21B. Smooth oblate ascospores with a depression in one face. Fig. 21C. Ascospores and enlarged, 0- or 1-septate arthroconidia. Figs. 21D-21F. Arthroconidia borne on the primary hyphae or on straight lateral branches. Fig. 21G. Uncinate appendage of the Malbranchea state. Fig. 21H. Uncinate appendage arising as a thick-walled extension from the vegetative hypha. Fig. 21I. Mature arthroconidia. Fig. 21J. Branched uncinate appendage of the Malbranchea state. B x 1680, H and J x 240, others x 600.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The presence of fertile gymnothecia in two isolates (UAMH 2845 and 3484) of ? Gymnoascus species, associated with a Malbranchea conidial state, prompted initial investigation of compatibility among several similar Malbranchea strains. Fertile crosses confirmed the sexual state to be Uncinocarpus reesii.

The two methods of inoculations used were mixed conidial suspensions (method A) and parallel inoculations of separate conidial suspensions (method B). Parallel inoculation of separate conidial suspensions (B) had the advantage that fertile gymnothecia could be easily located in the region between the tester strains, which had less dense vegetative growth. One of the problems associated with sexual crosses of Gymnoascaceae is the formation of profuse pleomorphic overgrowth which obscures gymnothecia. This degeneration occurred less rapidly in the streak-plate cultures. Gymnothecia were never formed in great abundance and when small were difficult to differentiate from clumps of conidia. Furthermore, if strains were in fact inhibitory, a readily apparent demarcation zone could be observed between the tester strains.

B. Results of crosses

The compatibility among isolates of the Malbranchea state of U. reesii is summarized in Table IV. Of the 19 wild type isolates tested, six were found to be incompatible with all other strains and with each other. The incompatible strains, UAMH 160, 1273, 1706, 1955, 2992 and 3573, resembled the others in microscopic morphology although UAMH 3573 also formed ascomatal initials in abundance. All wild type isolates were self-sterile.

C. F1 progeny

Two single ascospore progeny of the self-fertile UAMH 2845, determined to be opposite mating types by back crossing with each other, were designated + (UAMH 3881) and - (UAMH 3880) mating types. All F1 progeny were self-sterile. These tester strains when back crossed with four wild conidial isolates known to be fertile, resulted in two fertile crosses, UAMH 2002 x 3881 and UAMH 2847 x 3880 (Table IV). UAMH 2854 and 3485 failed to cross with either mating type (Table IV).

Six wild type isolates incompatible with all other conidial isolates (see Results of crosses) failed to cross with either of these two tester strains. In addition, two F1 progeny from the cross of UAMH 2002 x 2847, found to be + (UAMH 3915) and - (UAMH 3916) mating types by back crossing with the parent strains, were also incompatible with all six wild type isolates.

TABLE IV
SUMMARY OF THE FERTILE CROSSES OF UNCINOCARPUS REESII

	+ Plus mating strains						
- Minus Strains	1704	2847	2854	2855	2991	3703	3881
2002	+++	+++	+++	++	++	+++	+++
2050	++	+++	-	+++	-	-	N
2852	+	-	-	+++	-	-	N
2862	-	-	-	++	-	-	N
3257	-	-	-	+++	-	-	N
3258	+	-	-	+++	-	-	N
3485	+	+++	++	+	-	-	-
3880	N	+++	-	N	N	N	+++

+ < 10 gymnothecia
++ 10-20 gymnothecia
+++ > 20 gymnothecia
N Not tested

Increased fertility of mating strains from the progeny of fertile crosses has been reported for other Gymnoascaceae (Kwon-Chung, 1971, 1972; Padhye and Carmichael, 1971, 1973). More work is required to determine if the failure of the six wild type isolates to cross is due to incompatibility or whether the *Malbranchea* state is a complex similar to that of *Microsporum gypseum* (Stockdale, 1963) or *Trichophyton terrestre* (Padhye and Carmichael, 1973).

Material Examined
Single ascospore isolates, Alberta, L. Sigler, 1975: UAMH 3882, TYPE, dried colonies of cross of UAMH 3880 x 3881; UAMH 3880, - mating type, isolate 'A' of UAMH 2845; UAMH 3881, + mating type, isolate 'E' of UAMH 2845; UAMH 3883, - mating type, ('B' of UAMH 2845); UAMH 3884, - mating type, ('C' of UAMH 2845); UAMH 3915, + mating type, ('E' of cross of UAMH 2002x2847); UAMH 3916, - mating type, ('A' of cross of UAMH 2002x2847); From keratinous material (self-fertile isolates): UAMH 2845, feathers, Aust., R.G. Rees (F143), 1967, (Orr 0-3406; NRRL A-14871; QM 9335); UAMH 3484, feathers, Aust., R.G. Rees (F122), (Orr 0-3144; NRRL A-14870); From keratinous material: UAMH 2862, feathers, Aust., R.G. Rees (F122), ?1965, from Orr; UAMH 3485, feathers, Aust., (Orr 0-3047); UAMH 3843, feathers of *Corvus monedula*, Krivogastani, Yug., Z. Hubalek, 1968, as 193D (0-1296); UAMH 3846, nest of *Carduelis cannabina*, Valtice, Czech., Z. Hubalek, 1970, as 539A (0-1304); 0-3367, feather of Jackdaw, Yug., Z. Hubalek, (766A), from Orr; From rodent lung: UAMH 160, *Sylvilagus auduboni*, Texas, C.E. Emmons, 1949 (C 3716); From unknown sources: UAMH 2991, from R.S. Pore, W. Virginia Medical Center, Morgantown as 707; UAMH 2992, from Pore as 718; From human sources (from Orr): 0-2559, sputum, Mo., Bransberg (118); 0-3222, child's hair, Arg., Negroni (274); 0-3718, child's hair, Arg., Negroni (276); 0-782, child's hair, Arg., Negroni(255), from Orr; From soil, California isolates: UAMH 1704, G.F. Orr, 1960, (0-2080); UAMH 1706, G.F. Orr, 1957, (0-482a); 0-216, G.F. Orr; 0-2569, G.F. Orr; Hungarian isolates, Szathmary, 1967 (from Orr): UAMH 2847, fabric bait (0-3513); UAMH 2854, fabric bait (SZ 284); UAMH 2855, fabric bait (SZ 303); Italian isolates: UAMH 2002, E. Varsavsky, 1964, from Orr, (EV 1-14); UAMH 2050, from Varsavsky (I-79); UAMH 2852, E. Varsavsky, 1964, (Orr I-26); UAMH 3573, E. Varsavsky, (Orr 0-3407); UAMH 3819, E. Varsavsky (I-5), (Orr 0-3344); UAMH 3820, E. Varsavsky (I-15), (Orr 0-3233); UAMH 3918, Pavia, G. Caretta (E 21 +), (Orr 0-1322); 0-1323, Pavia, G. Caretta (E 25), from Orr; 0-1324, Pavia, G. Caretta, (E 9 I+), from Orr; South American isolates: UAMH 1955, Arg., E. Varsavsky, (Orr EV-50; 0-3597); 0-3451, Arg., Negroni (408), from Orr; UAMH 1273, Venez., Pollak (5770) from Ajello, CDC 45-36-62; 0-2558, Mexico, Plunkett (707), from Orr; Indian isolates: UAMH 3257, from H.C. Gugnani, National Institute of

Communicable Diseases, Delhi, as S673; UAMH 3258, from Gugnani as S1038; 0-2081, Garg (1045), from Orr.

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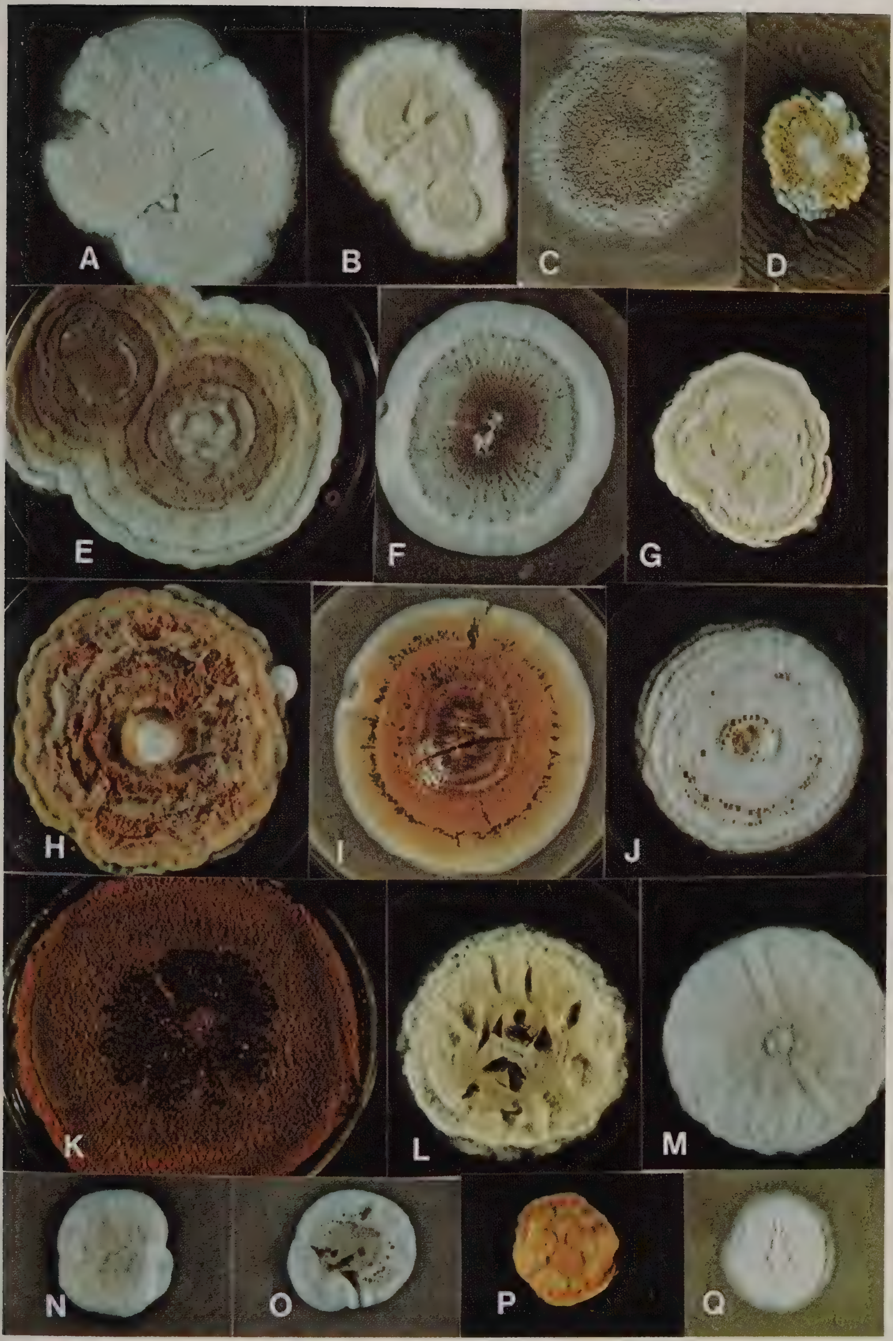
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NOTES ON HYPHOMYCETES. XII.
A NEW SPECIES OF *CHALARA*.

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ABSTRACT

Chalara alabamensis Morgan-Jones and Ingram is described and illustrated from leaves of *Quercus nigra* in Alabama. It is compared with *C. hughesii* Nag Raj and Kendrick.

INTRODUCTION

A survey of microfungi associated with leaf litter of *Quercus nigra* L., in Alabama, has yielded a number of interesting and novel dematiaceous hyphomycetes. Among these is a fungus belonging to the genus *Chalara* (Corda) Rabenh. A comparison of two collections of it with species described by Nag Raj and Kendrick (1975) in their recent monograph of the genus indicates a broadly similar morphology to *Chalara hughesii*. It cannot, however, be considered to be conspecific with it.

TAXONOMIC PART

Chalara alabamensis sp. nov. (Fig. 1).

Coloniae hypophyllae, effusae, pallide brunneae, velutinae. Mycelium partim superficiale, partim in substrato immersae. Conidiophora macronemata, mononemata, solitaria, simplicia, recta, laevia, 46 - 87μm longa. Phialides lageniformes, 40 - 82 X 3 - 7μm, pallide brunneae, laeves, venter subcylindraceus, 14 - 17 X 6 - 7μm, collum cylindraceum, 30 - 53 X 3 - 4μm. Phialospora endogena in catenis sporidiis maturis apice, cylindracea, 1-septata, hyalina, laevia, 15 - 18 X 2 - 2.5μm.

In foliis emortuis *Quercus nigrae*, Chewacla State Park, Lee County, Alabama, April 1976, E. G. Ingram, BPI, holotypus.

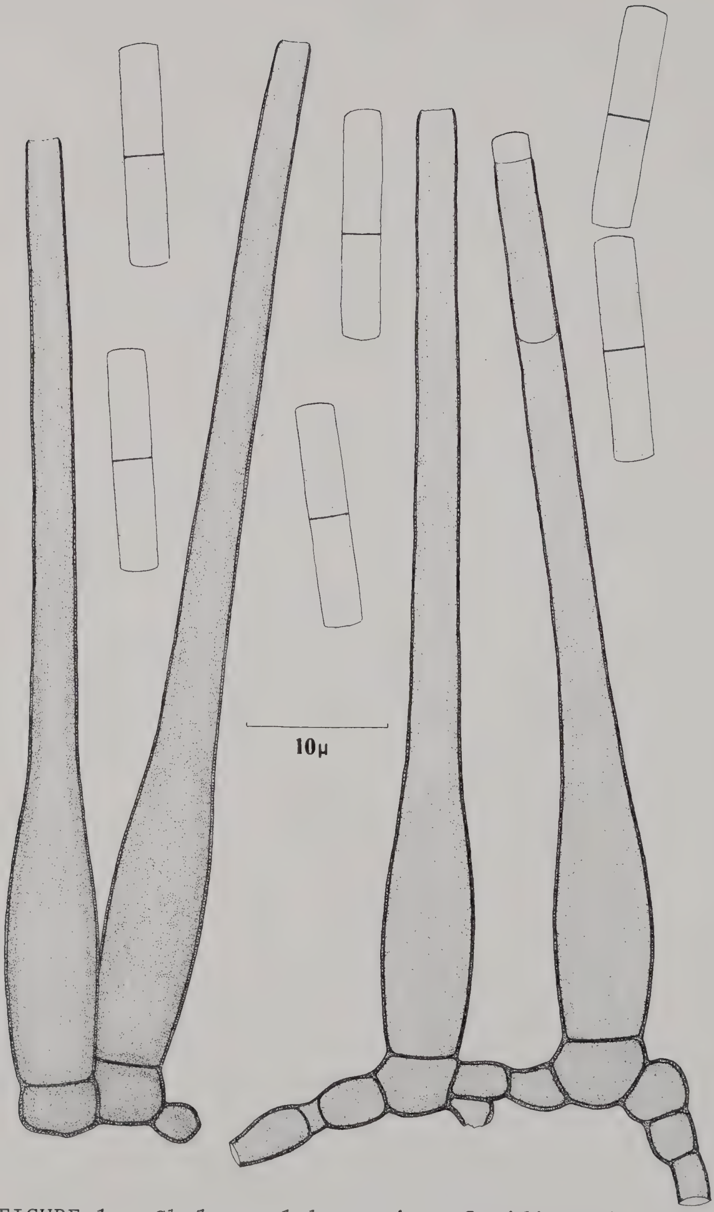

FIGURE 1. *Chalara alabamensis*. Conidia and conidiophores.

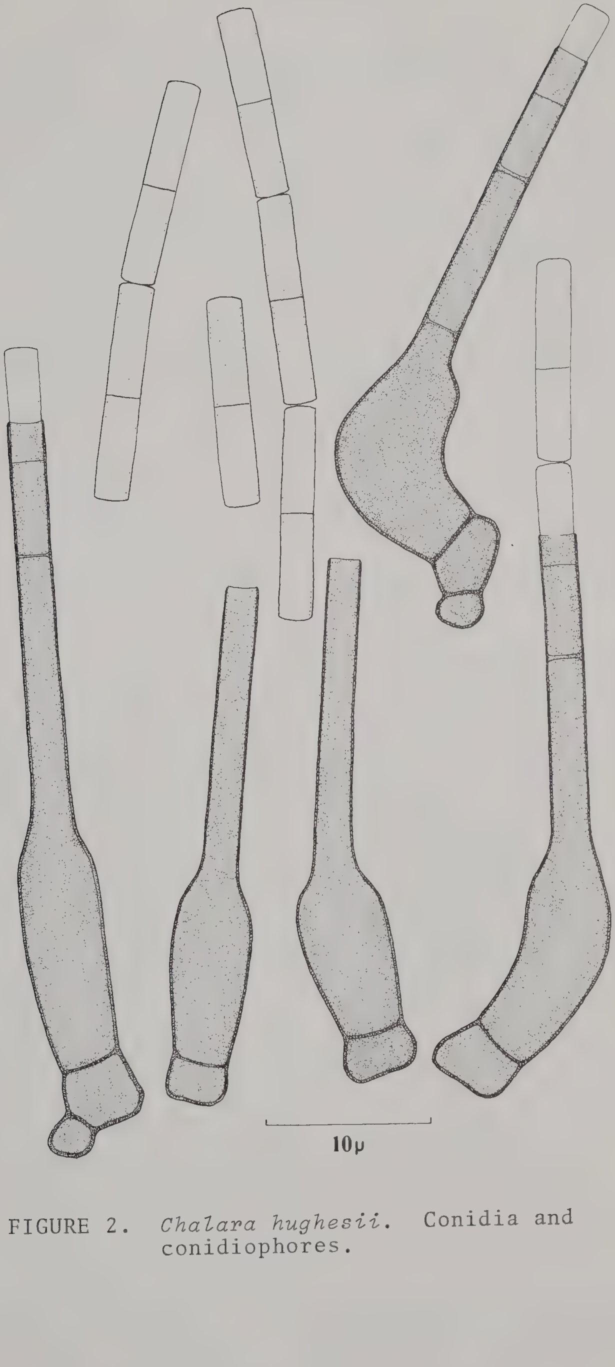

FIGURE 2. *Chalara hughesii*. Conidia and conidiophores.

Colonies hypophyllous, effused, dark brown, velutinous. Mycelium partly superficial, partly immersed in the substratum. Immersed mycelium composed of branched, septate, subhyaline hyphae, 1.5 - 2μm wide, superficial mycelium composed of swollen, pale brown, somewhat thick-walled hyphal cells. Conidiophores macronematous, mononematous, phialidic, solitary, scattered or gregarious, simple, erect, smooth, arising directly from cells of the superficial mycelium or from short basal cells, 46 - 87μm long. Phialides lageniform, 40 - 82 X 3 - 7μm, pale brown, with a subcylindric venter, 14 - 17 X 6 - 7μm, and a long cylindric collarette which attenuates very gradually towards the apex, 30 - 53 X 3 - 4μm, transition from venter to collarette gradual. Phialoconidia endogenous, produced in basipetal chains, cylindrical, 1-septate, hyaline, smooth, truncate at each end, lacking a basal marginal frill, 15 - 18 X 2 - 2.5μm.

On dead leaves of *Quercus nigra*; North America.

Collections examined: on *Q. nigra*, Chewacla State Park, Lee Co., Alabama, April 1976, E. G. Ingram, BPI, AUA, type; on *Q. nigra*, Auburn University Forestry Plots, Auburn, Lee Co., Alabama, April 1976, E. G. Ingram, AUA.

C. alabamensis belongs to a group of species possessing 1-septate conidia and conidiophores consisting of phialides borne directly from superficial mycelium or from a single short stalk cell. It resembles *C. agathidis* Nag Raj and Kendrick and *C. angionacea* Nag Raj and Kendrick, as well as *C. hughesii*, in these respects. It differs from the former two species, as does *C. hughesii*, in the absence of a basal circumjacent frill on the conidia, as well as in conidium dimensions and coloration of the phialides. Its conidia are closely similar to those of *C. hughesii* but are consistently slightly longer. Moreover the phialides are much longer than those of *C. hughesii* (Fig. 2, on wood, Lloyd-Cornell Preserve, Ringwood, New York, September 5, 1952, S. J. Hughes, DAOM 29354, type), and in that species the transition from venter to collarette is regularly abrupt and the phialides are frequently distinctly curved.

ACKNOWLEDGMENT

We thank Miss Mary E. Elliott for kindly making available for examination the type collection housed at the Biosystematics Research Institute, Ottawa, Canada, and Dr. J. Leland Crane for his review of the manuscript.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. XIII. CONCERNING TWO SPECIES OF *PHAEOISARIOPSIS*.

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ABSTRACT

Cercospora liriodendri is reclassified in *Phaeoisariopsis* and together with *Phaeoisariopsis magnoliae* is redescribed and illustrated.

INTRODUCTION

Study of a fresh collection of *Cercospora liriodendri* Ell. and Harkn., made in Alabama on leaves of *Liriodendron tulipifera* L., and of its type specimen has indicated that this species has closer affinity with *Phaeoisariopsis* Ferraris than with *Cercospora* Fresenius. *Cercospora magnoliae* Ell. and Harkn., a closely related fungus considered by Chupp (1953) to be conspecific with *C. liriodendri*, was transferred by Jong and Morris (1968) to *Phaeoisariopsis*. Hodges and Hassis (1962) had previously correctly recognized *C. magnoliae* to be distinct from *C. liriodendri* and to be congeneric with *Isariopsis griseola* Sacc., the type species of *Phaeoisariopsis*.

C. liriodendri and *P. magnoliae*, the cause of leaf spot diseases of their respective magnoliaceous hosts, produce conidia which differ but slightly in shape, dimension and septation and both produce fasculate conidiophores characteristic of the genus *Phaeoisariopsis*. *P. magnoliae* is herein redescribed and illustrated from its type; *C. liriodendri* is illustrated, redescribed and reclassified in *Phaeoisariopsis*.

TAXONOMIC PART

Phaeoisariopsis liriodendri (Ell. and Harkn.) comb. nov. (Fig. 1).

≡ *Cercospora liriodendri* Ellis and Harkness, Bull. Torrey Bot. Club 8:27, 1881.

Leaf spots mostly angular, bordered by leaf veins, olive green, 2 - 3mm in diameter. Colonies limited, brown. Mycelium immersed in the substratum, composed of branched, septate, pale brown hyphae, 3 - 5μm wide. Stromata prosenchymatous, immersed, occasionally partially exposed, up to 70μm wide. Conidiophores hypophyllous, macronematous, mononematous, densely fasciculate, arising from the upper cells of the stromata, straight to somewhat flexuous, smooth-walled, simple, cylindrical, slightly wider distally, geniculate above, scars thin but distinct, pale brown, paler towards the tip, 3 - 5-septate, 55 - 150 X 3 - 4μm. Conidiogenous cells polyblastic, indeterminate, terminal, integrated. Conidia holoblastic, solitary, dry, acrogenous, straight, pyriform to broadly fusiform, pale brown, delicately verruculose, 1 - 3-septate, mostly 1-septate, apex obtuse, base subtruncate, scars thin, 20 - 29 X 6μm at widest part.

On leaves of *Liriodendron tulipifera* L.; N. America. Specimens examined: on *L. tulipifera*, Vineland, New Jersey, U.S.A., October 1880, J. B. Ellis and H. W. Harkness, North American Fungi No. 645, type, NY; on *L. tulipifera*, Auburn, Lee County, Alabama, U.S.A., April 1976, L. G. Brown, AUA.

Phaeoisariopsis magnoliae (Ell. and Harkn.) Jong and Morris, Mycopathol. et Mycol. Appl. 34:271, 1968 (Fig. 2).

≡ *Cercospora magnoliae* Ellis and Harkness, Bull. Torrey Bot. Club 8:27, 1881.

≡ *Isariopsis magnoliae* Plakidas, Mycologia 52:258, 1960.

Leaf spots suborbicular to angular, sometimes bordered by leaf veins, center grayish with raised dark brown to black margin, up to 3mm in diameter. Colonies limited, evenly spaced, deep olivaceous to dark brown. Mycelium immersed in the substratum, composed of branched, septate, pale brown, 3 - 5μm wide hyphae. Stromata largely immersed, prosenchymatous to pseudoparenchymatous, disc-shaped, up to 70μm wide. Conidiophores hypophyllous, macronematous, mononematous, densely fasciculate, arising from the upper cells of the stromata, simple, straight or flexuous, somewhat geniculate distally, smooth-walled, pale brown, relatively thick-walled, multiseptate, scars distinct but thin, 100 - 225 X 2.5 - 4μm. Conidiogenous cells polyblastic, cylindrical, integrated, terminal or intercalary, sympodial. Conidia holoblastic, solitary, dry, acropleurogenous, straight to slightly curved, verruculose, obclavate, 1 to 3-septate, mostly 2-septate, apex obtuse, base conico-truncate, scars thin, 23 - 42.5 X 5 - 6.5μm.

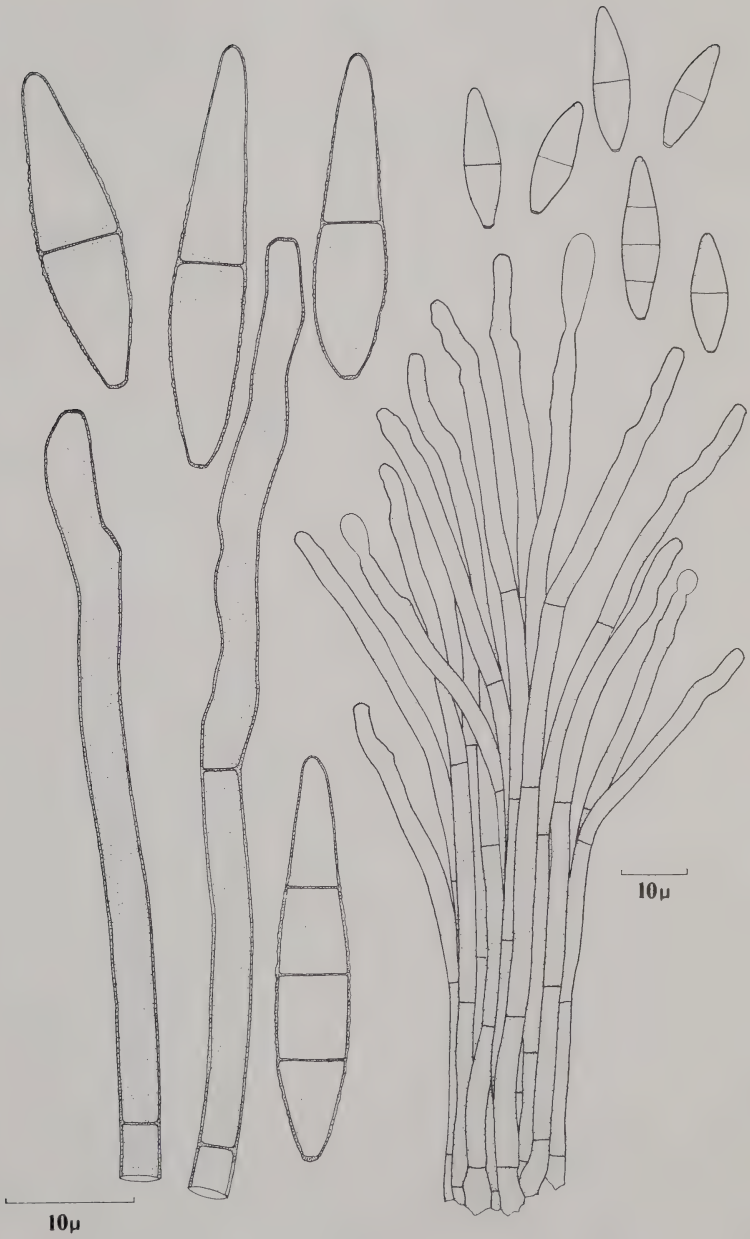

FIGURE 1. *Phaeoisariopsis liriodendri*. Conidia and conidiophores.

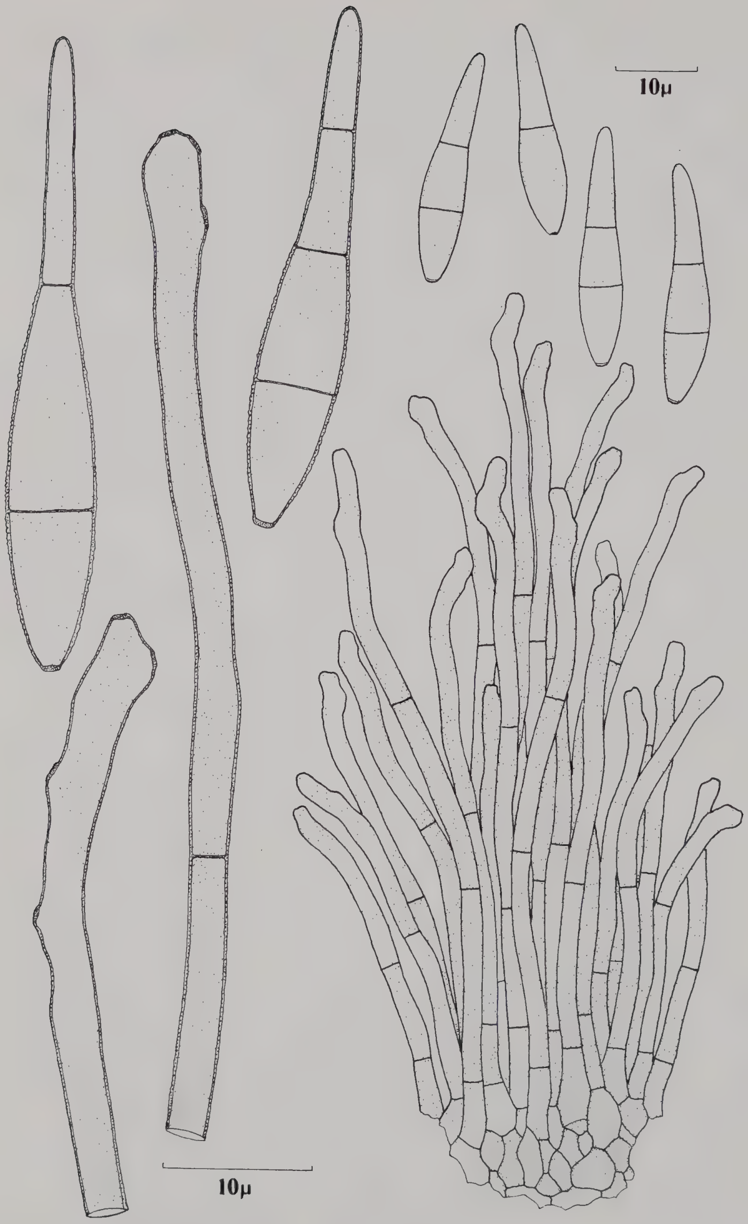

FIGURE 2. *Phaeoisariopsis magnoliae.* Conidia and conidiophores.

On leaves of *Magnolia* species; N. America. Specimens examined: on *M. virginiana* L. (*M. glauca* L.), Newfield, New Jersey, U.S.A., November 1880, J. B. Ellis and H. W. Harkness, North American Fungi No. 643 type, NY; on *M. virginiana*, Newfield, New Jersey, U.S.A., September 23, 1883, J. B. Ellis, NY (Ellis placed the name *Cercospora glauca* Ell. and Everh., on this collection but the name was never published.).

In some respects these two fungi bear resemblance to species of *Fusicladium* Bonorden. The shape of the conidia and the minutely verruculose nature of the conidium wall are similarities.

ACKNOWLEDGEMENTS

We thank Dr. Clark T. Rogerson, New York Botanical Garden, for making available for examination the two type specimens. Dr. Roger D. Goos, University of Rhode Island, kindly reviewed the manuscript.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. XIV.
THE GENUS *HETEROCONIUM*.

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ABSTRACT

Helminthosporium solaninum Saccardo and Sydow is transferred to the genus *Heteroconium* Petrak and, together with *Heteroconium citharexyli* Petrak, the type species of this genus, is redescribed and illustrated.

INTRODUCTION

The genus *Heteroconium* was established by Petrak (1949) to accommodate a dematiaceous hyphomycete possessing cylindrical, septate conidia borne in unbranched chains on well differentiated but short conidiophores formed from a largely superficial mycelium. The fungus occurred on living leaves of *Citharexylum ilicifolium* in Ecuador. Petrak considered *Heteroconium* in relation to *Dendryphion* Wallroth noting the very short, simple conidiophores of the former to be a point of difference. A more fundamental distinction between these two genera lies in the fact that the conidiogenous cells of *Dendryphion* are tretic whereas those of *Heteroconium* are blastic, a relatively wide wall area at the conidiophore and conidium apex being involved in conidiogenesis.

Morgan-Jones (1975), in a discussion of the affinities of *Lylea catenulata* Morgan-Jones restated the unique characteristics of *Heteroconium*.

Examination of the type collection of *Helminthosporium solaninum* Saccardo and Sydow made on living leaves of *Solanum argenteum* in Brazil has revealed it to be a second species of *Heteroconium*. Since its establishment this species has been reclassified in *Sporohelminthium* Spegazzini and *Septonema* Corda but neither of these genera provide a fully satisfactory disposition for it.

Sporohelminthium is now recognized as a synonym of *Clasterosporium* Schweinitz, its type species *S. anomalum* (Speg.) Speg., which had originally been classified in *Napicladium* Thümen, being clearly congeneric with *Clasterosporium caricinum* Schweinitz on which the latter genus is based. The catenate nature of the conidia and the absence of hyphopodia precludes the classification of *H. solaninum* in *Clasterosporium*.

H. solaninum has more affinity with *Heteroconium* than with *Septonema*, as exemplified by its type *S. secedens* Corda, on a number of accounts particularly its superficial habit on leaves in the tropics, its monoblastic conidiogenous cells and its simple conidium chains.

Hughes (1958) listed *Dendryphion loranthi* Hansford as a synonym of *H. solaninum*. He had previously (Hughes, 1952) transferred this to *Septonema* as *Septonema loranthi* (Hansf.) Hughes. Although the type material on which this name is based has not been examined during the present study this synonymy is accepted here.

Helminthosporium solaninum is transferred to *Heteroconium* and both it and *H. citharexyli* are redescribed and illustrated.

TAXONOMIC PART

Heteroconium citharexyli Petrak, Sydowia 3:265, 1959 (Fig. 1).

Colonies effuse, olivaceous to dark brown, hypophyllous, abundant. Mycelium superficial, composed of flexuous, branched, pale olive brown to olive brown, smooth-walled, 3-5µm wide hyphae. Conidiophores macronematous, mononematous, simple, arising as lateral branches of the superficial hyphae, erect, straight or slightly curved, cylindrical, brown, smooth-walled, multiseptate, septa relatively closely spaced, sometimes somewhat bulbous at the base when arising from narrower hyphae, 10-32 X 4-7µm. Conidiogenous cells monoblastic, integrated, determinate or percurrent, terminal on the conidiophore or as an apical cell of the conidium. Conidia catenate, dry, acrogenous, simple, smooth-walled, pale brown to brown, straight, cylindrical, formed in short unbranched acropetal chains, obtuse at the apex, truncate at the base, 1 to 7-septate, slightly constricted at the septa, 10-40 X 3-7µ.

On leaves of *Citharexylum ilicifolium* H.B. and K.; South America.

Specimen examined: on *C. ilicifolium*, Pichincha, Quito, Ecuador, September 29, 1937, H. Sydow, type, S.

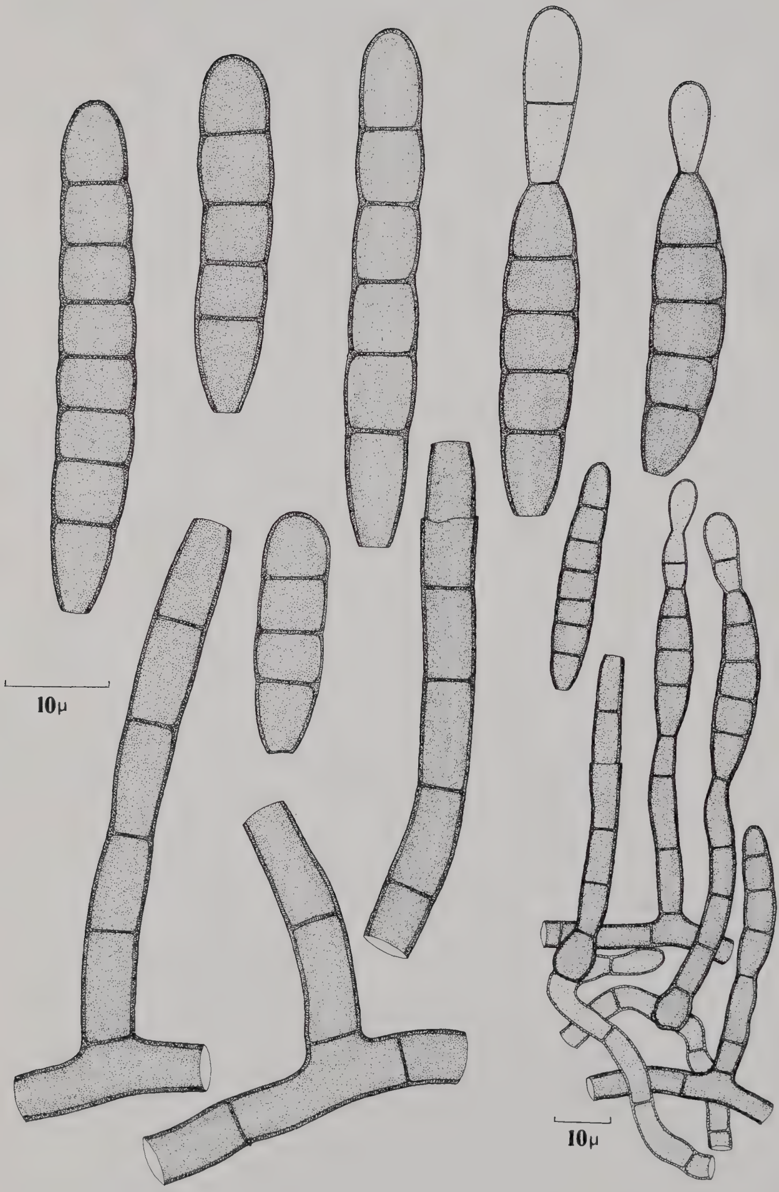

FIGURE 1. *Heteroconium citharexyli*. Conidia and conidiophores.

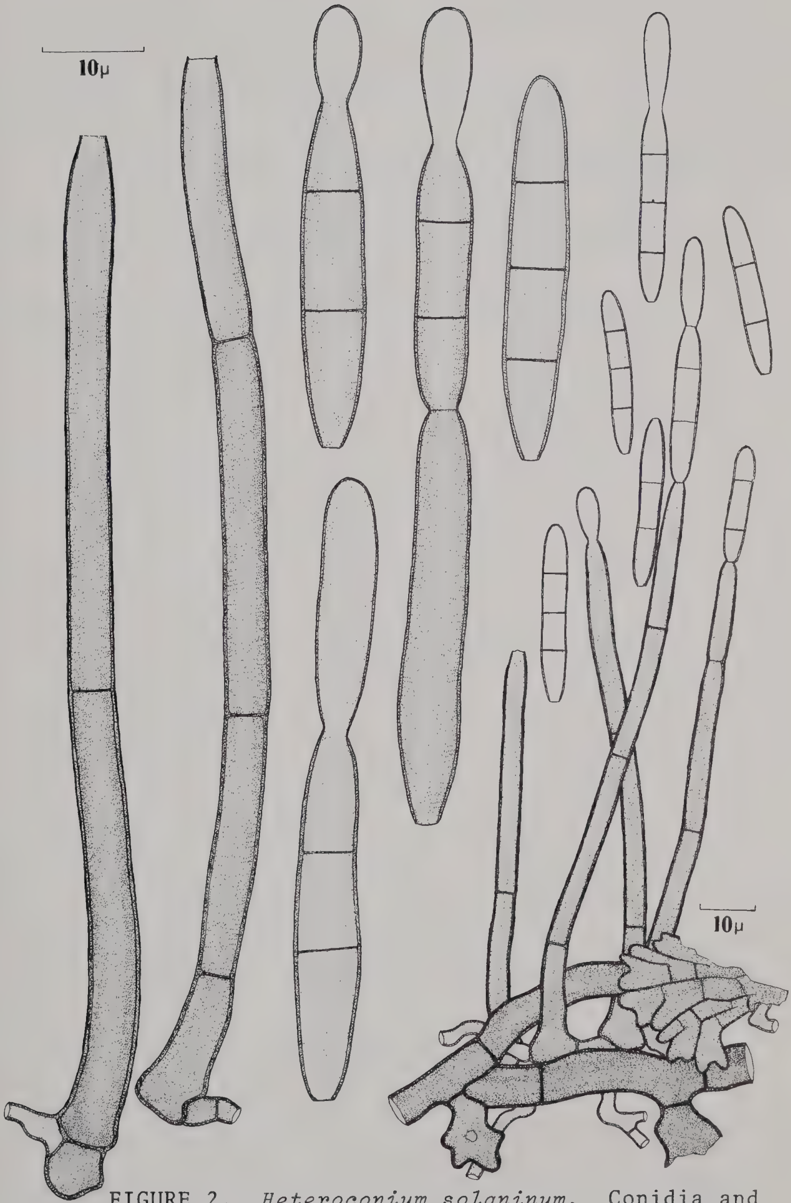

FIGURE 2. *Heteroconium solaninum*. Conidia and conidiophores (conidiophores on *Asterina* sp.).

Heteroconium solaninum (Sacc. and Syd.) comb. nov. (Fig. 2).

≡ *Helminthosporium solaninum* Saccardo and Sydow, Atti Congr. bot. Palermo 58, 1902.

≡ *Sporohelminthium solaninum* (Sacc. and Syd.) Spegazzini, Physis. 4:292, 1918.

≡ *Septonema solaninum* (Sacc. and Syd.) Hughes, Can. J. Bot. 36:804, 1958.

= *Dendryphion loranthi* Hansford, Proc. Linn. Soc. Lond., 155:46, 1943 [fide Hughes, 1958].

= *Septonema loranthi* (Hansf.) Hughes, Naturalist, Lond., 12, 1952.

Colonies effuse or somewhat orbicular, dark brown, epiphyllous. Mycelium superficial, composed of flexuous, branched, septate, pale brown to brown, smooth-walled, 3-4μm wide hyphae. Conidiophores macronematous, mononematous, simple, arising as lateral branches of the superficial hyphae, erect, straight or slightly curved, smooth-walled, 1 to 4-septate, frequently somewhat bulbous at the extreme base, brown, paler distally, 50-78 X 3-5μm. Conidiogenous cells monoblastic, integrated, determinate, terminal on the conidiophore or as an apical cell of the conidium. Conidia catenate, dry, acrogenous, simple, smooth-walled, formed in unbranched acropetal chains, seceding readily, straight, cylindrical, obtuse at the apex, truncate at the base, or truncate at each end, 0 to 3-septate, septa appreciably thinner than the periclinal wall, pale brown, 16-24 X 4-4.5μm

On living leaves associated with *Meliola* spp., *Asterina* spp., and other fungi; Africa and South America.

Specimens examined: on *Solanum argenteum* Dun. ex Poir., Rio de Janeiro, Brazil, September 1887, E. Ule (1461), type, S, PAD; on *Garcina huillensis* Welw., Kahama, Kigoma, Tanzania, February 7, 1974, K. A. Pirozynski, IMI 106494b, AUA.

Hughes (1952) reported the occurrence of this species in Uganda, Ghana and Sierra Leone (as *Septonema loranthi*).

ACKNOWLEDGEMENTS

I thank the curators of the herbaria at Padova and Stockholm for the loan of type specimens. The manuscript was kindly reviewed by Dr. Richard T. Hanlin, University of Georgia.

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NOTES ON HYPHOMYCETES. XV. TWO NEW SPECIES OF *CODINAEA*.

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ABSTRACT

Codinaea cylindrospora Morgan-Jones and Ingram and *Codinaea unisetula* Morgan-Jones and Ingram are described and illustrated from leaves of *Quercus nigra* in Alabama.

INTRODUCTION

Among new hyphomycetes collected from leaf litter of *Quercus nigra* L. in Alabama, in addition to *Chalara alabamensis* Morgan-Jones and Ingram described in a previous paper (Morgan-Jones and Ingram 1976), are two species of *Codinaea* Maire. Both are strikingly different in their respective morphologies from species of this genus known hitherto. Hughes and Kendrick (1968) provided a review of *Codinaea* adding nine new species, transferring to it two species from *Menispora* and describing three as states of new species of *Chaetosphaeria* Tulasne. Since the two fungi which form the subject of this paper cannot be assigned to any previously documented species, names are established for them herein.

TAXONOMIC PART

Codinaea cylindrospora sp. nov. (Fig. 1).

Coloniae hypophyllae, effusae, atro-brunneae vel atrae. Mycelium ex hyphis immersis, semimmersis vel superficialibus, subhyalinis vel brunneis, in stromata basibus setarum et conidiophorarum aggregatis, compositium. Setae erectae, rectae, leaves, usque ad 125μm longae, usque ad 6-septatae, ex cellulis basilaribus, inflatis oriundae, basi 5 - 8μm latae, atrobrunneae et crassitunicatae, superne pallidiores, apicem pallide brunneae vel subhyalinae. Setae in phialide singula terminantes. Conidiophora singulariter oriunda vel 2 - 4 aggregata, simplicia,

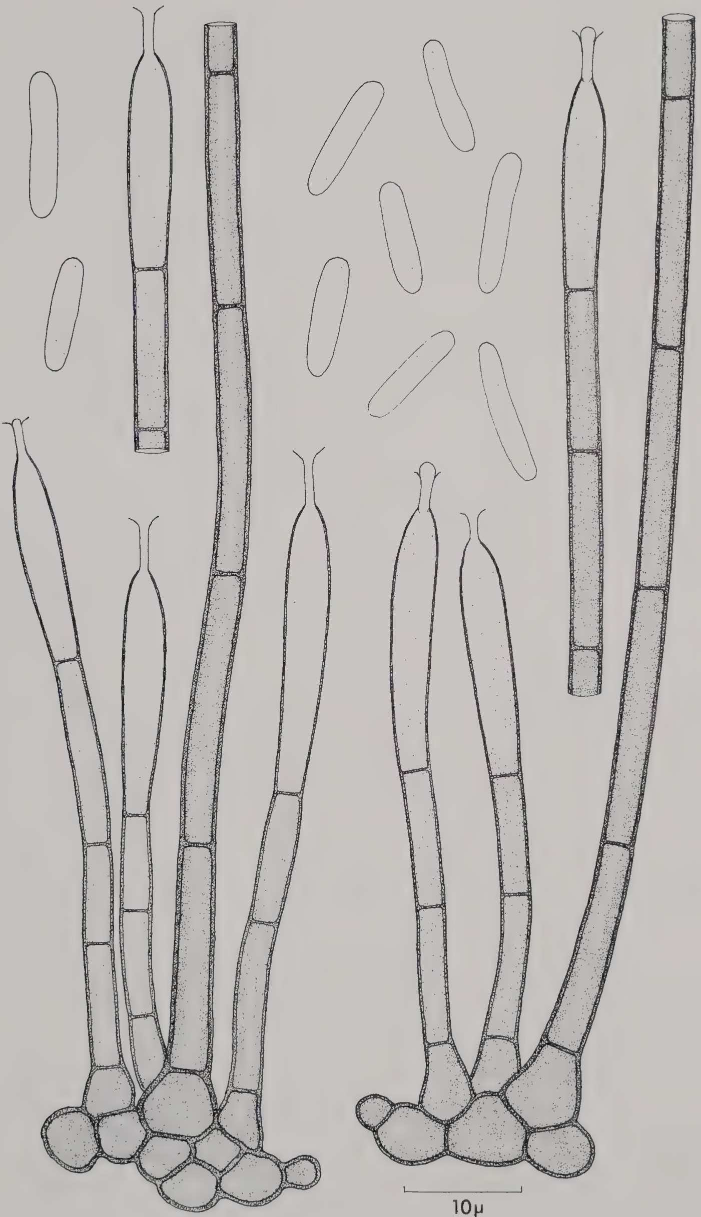

FIGURE 1. *Codinaea cylindrospora*. Conidiophores and conidia.

erecta, cylindrica vel anguste clavata, basi brunnea, apicem versus pallidiora, usque ad 3-septata, 30 - 60 X 2.5 - 4μm. Conidiophora in phialide singula terminantia. Phialides rectae, pallide brunneae vel subhyalinae, colla infundibuliformia. Conidia (phialoconidia) continua, hyalina, cylindracea, recta, 8 - 11 X 2 - 2.5μm, in capitulum mucosum incoloratum aggregata.

In foliis dejectis *Quercus nigrae*, Auburn University, Lee County, Alabama, April 1976, E. G. Ingram, BPI, holotypus.

Colonies hypophyllous, effused, dark brown to almost black. Mycelium composed of immersed, semi-immersed or superficial, branched, septate, subhyaline to pale brown hyphae, 1.5 - 2.5μm wide, aggregated to form small stromata at the bases of setae and conidiophores. Stromatic cells globose or angular, thick-walled, brown, up to 7μm wide. Setae arising from dark brown, swollen basal cells, erect, straight, smooth, up to 6-septate, dark brown and thick-walled in the lower part, paler above, fertile, terminating in a single, narrowly clavate phialide, 105 - 125 X 3 - 4μm, 6 - 7μm wide at the bulbous base. Conidiophores macronematous, mononematous, arising in groups of up to four near the base of each seta, cylindrical, with a somewhat swollen basal cell, simple, septate, smooth, 30 - 60 X 2.5 - 4μm, terminating in a single, pale brown to subhyaline, narrowly clavate phialide, each phialide bearing a single apical, funnel-shaped, stalked collarette. Conidia (phialoconidia) extruded in slimy colorless droplets, continuous, hyaline, cylindrical, straight or very slightly curved, obtuse at each end, 8 - 11 X 2 - 2.5μm.

On fallen leaves of *Quercus nigra*; N. America.

Collection examined: On *Q. nigra*, Auburn University Forestry Plots, Auburn, Lee County, Alabama, April 1976, E. G. Ingram, BPI, AUA, type.

C. cylindrospora is not entirely typical of *Codinaea* as defined by Hughes and Kendrick (1968) on account of the absence of phialidic proliferation to produce polyphialides. However, in overall morphology, it is so similar to species of this genus as to dictate its inclusion in it. Moreover the conidiophore of the type species of *Codinaea*, *C. aristata* Maire, the location of whose type specimen is unknown, was described and illustrated by Maire (1937) as monophialidic ("apex of fertile hypha forming spores"). In the absence of sympodial proliferation *C. cylindrospora* resembles *Cyphellophora* de Vries. This species cannot be accommodated in this genus for several reasons, however. In *Cyphellophora laciniata* de Vries, the type species, the hyphae have very little pigment, the collarettes are predominately sessile and the conidia, which become brown when mature, are distinctly constricted at a central septum. None of these peculiarities are exhibited by *C. cylindrospora.*

Apart from other morphological details *C. cylindrospora* differs from *C. aristata* by the absence of conidial appendages. In this respect it resembles the *Codinaea* states of *Chaetosphaeria callimorpha* (Mont.) Sacc., and *Chaetosphaeria talbotii* Hughes, Kendrick and Shoemaker, *Codinaea botulispora* Hughes and Kendrick, *C. maharashtrensis* Pirozynski and Patil and *C. setosae* Hughes and Kendrick.

C. cylindrospora is distinguished from other species of *Codinaea* by its narrowly club-shaped phialides bearing relatively long, stalked collarettes, and by its straight or almost straight conidia.

Codinaea unisetula sp. nov. (Fig. 2).

Coloniae hypophyllae, effusae, griseo-brunneae vel atrae. Mycelium ex hyphis immersis vel semiimmersis, ramosis, subhyalinis vel brunneis, compositum. Setae desunt. Conidiophora singulariter oriunda vel 2 - 3 aggregata, simplicia, recta, cylindrica, basi brunnea, apicem versus pallidiora, usque ad 3-septata, 28 - 76 X 2 - 3µm. Conidiophora in polyphialide singula terminantia. Polyphialides rectae vel flexae, pallide brunneae vel subhyalinae, sympodialter per usque ad 3 proliferationes successivas elongascentes, usque ad 3 reliquias laterales collorum ferentes, colla infundibuliformia. Conidia (phialoconidia) continua, hyalina, fusiformia, recta vel leniter curvata, 6 - 7 X 1µm, ad apicem setula singula 13 - 15µm longa praedita, in capitulum mucosum incoloratum aggregata.

In folis dejectis *Quercus nigrae*, Chewacla State Park, Lee County, Alabama, April 1976, E. G. Ingram, BPI, holotypus.

Colonies hypophyllous, effused, gray-brown to black. Mycelium composed of immersed or semi-immersed, branched, septate, subhyaline to pale brown hyphae, 1.5 - 2µm wide. Hyphae giving rise to a few pale brown to brown, subglobose cells, up to 6µm wide associated with conidiophores. Setae absent. Conidiophores macronematous, mononematous, arising singly or in groups of up to three, cylindrical, usually attenuating slightly distally, with a swollen basal cell, simple, septate, smooth, straight or somewhat flexuous, 28 - 76 X 2 - 3µm, up to 6µm wide at the base, terminating in a single pale brown to subhyaline phialide or polyphialide bearing funnel-shaped collarettes. Conidia (phialoconidia) extruded in slimy colorless droplets, continuous, hyaline, fusiform, straight or very slightly curved, 6 - 7 X 1µm, bearing a single apical filiform appendage, 13 - 15µm long.

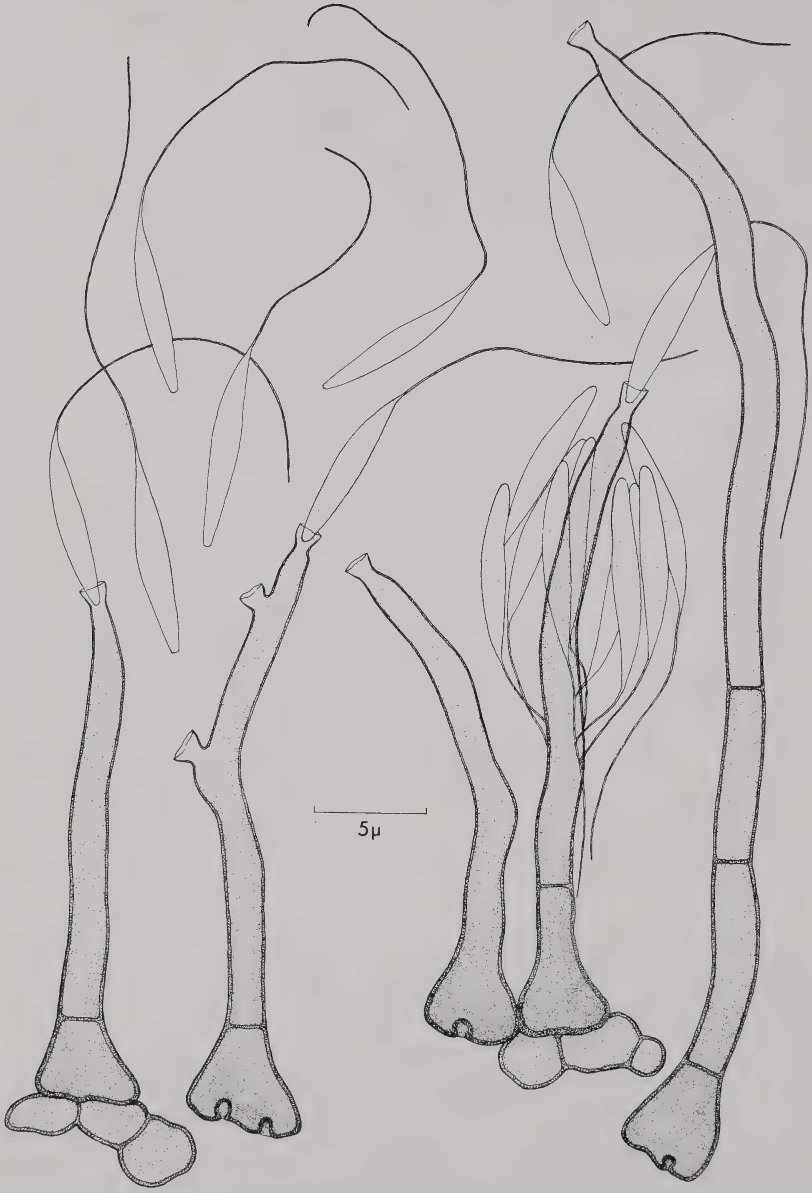

FIGURE 2. *Codinaea unisetula*. Conidiophores and conidia.

On fallen leaves of *Quercus nigra*; N. America.

Collection examined: On *Q. nigra*, Chewacla State Park, Lee County, Alabama, April, 1976, E. G. Ingram, BPI, AUA, type.

C. unisetula is distinguishable from all other species of *Codinaea* by its small fusiform conidia which bear single undulate appendages up to twice their length.

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We thank Dr. Roger D. Goos, University of Rhode Island, for reviewing this manuscript.

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NOTES ON HYPHOMYCETES. XVI.
A NEW SPECIES OF *STACHYBOTRYS*.

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ABSTRACT

Stachybotrys zeae Morgan-Jones and Karr, a new species, is described and illustrated from corn in Alabama. It is compared with *Stachybotrys chartarum* (Ehrenb. ex Link) Hughes.

INTRODUCTION

A fungus tentatively identified as *Stachybotrys chartarum* during a preliminary survey of hyphomycetes occurring on corn in Alabama appears upon detailed examination to be sufficiently different in a number of key characters to be considered as an undescribed taxon.

TAXONOMIC PART

Stachybotrys zeae sp. nov. (Fig. 1).

Coloniae effusae, grisea. Mycelium in substrato immersum, ex hyphis ramosis, septatis, hyalinis, levibus, 2 - 3µm crassis compositum. Conidiophora solitaria vel laxe aggregata, erecta, recta vel flexuosa, septata, cylindrica, laevia, hyalina, 48 - 85 X 3 - 5µm. Phialides terminales, 2 - 5 in verticillo dispositae, obovatae, leviae, salmonicolores, 9 - 11 X 4 - 5µm. Phialosporae in muco accumulatae, ellipsoideae, brunneae vel atrobrunneae, verrucosae, 7 - 9 X 3.5 - 4.5µm.

In folis *Zea mays* L., Camden, Wilcox County, Alabama, VII 1975, G. W. Karr, Jr., BPI, holotypus.

Colonies effuse, gray. Mycelium immersed in the substratum, composed of branched, septate, smooth, hyaline to subhyaline hyphae, 2 - 3µm wide. Conidiophores macronematous, mononematous, solitary or aggregated in loose

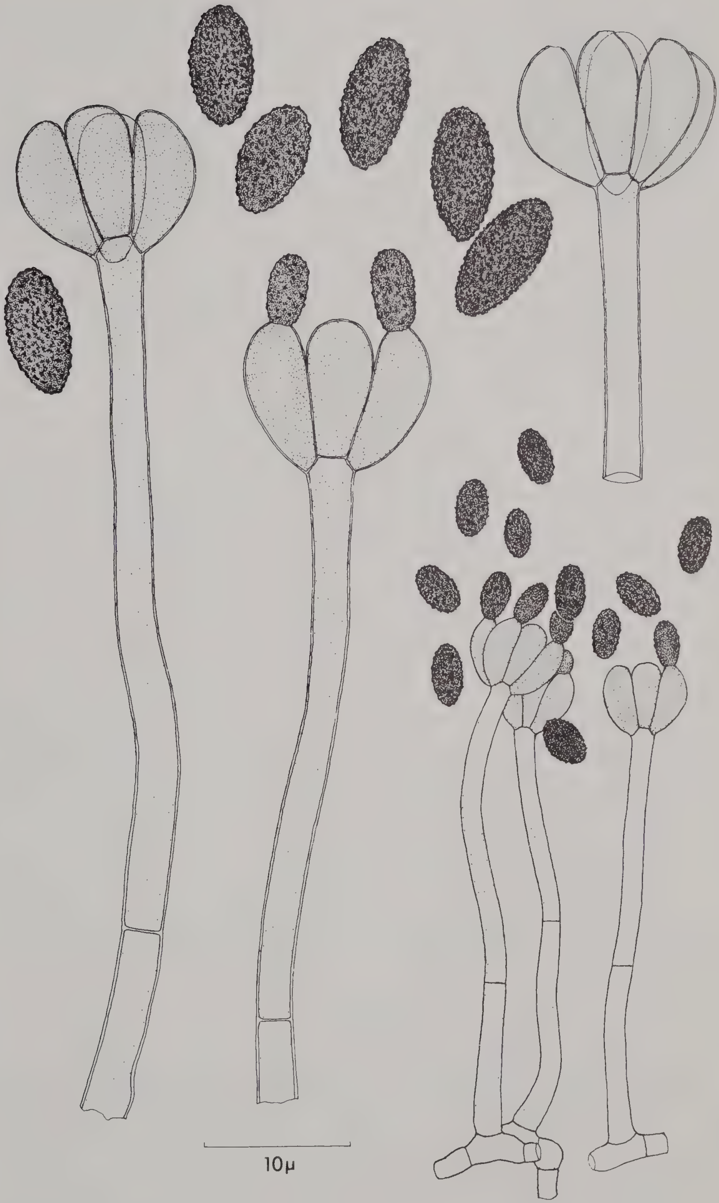

FIGURE 1. *Stachybotrys zeae.* Conidiophores and conidia.

groups of a few, erect, straight or somewhat flexuous, unbranched, cylindrical, attenuating slightly but gradually towards the upper part, septate, smooth, hyaline, 48 - 85 X 3 - 5μm, terminating in a verticil of phialides. Phialides formed in groups of up to five around the base of a central phialide, obovate, the outer ones somewhat curved, smooth, pale salmon-colored, producing conidia successively at the apex, 9 - 11 X 4 - 5μm. Phialospores ellipsoidal, unicellular, brown to dark brown, verruculose, 7 - 9 X 3.5 - 4.5μm.

On leaves of *Zea mays*; North America.

Specimen examined: On *Z. mays*, Auburn University Agricultural Experiment Station, Lower Coastal Plain Substation, Camden, Wilcox County, Alabama, July 1975, G. W. Karr, Jr., BPI, type.

Of the known species of *Stachybotrys* Corda, *S. zeae* most closely resembles *S. chartarum*. It differs from it however in a number of significant respects. The conidiophores are unbranched and their stipes are hyaline and smooth-walled whereas those of *S. chartarum* are usually branched and their stipes are dark olivaceous in color and roughened in the upper part. The phialides of *S. chartarum* are also dark olivaceous and have conspicuous collarettes. Those of *S. zeae* have no discernible collarettes and are distinctly salmon-colored. In addition the outer phialides of a whorl are generally more noticeably curved in *S. zeae* than are those occupying a similar position in *S. chartarum*. The conidia of *S. zeae* are smaller than is normal in *S. chartarum* although they fall almost within the range given for that species by Jong and Davis (1976). They do not however exhibit the very characteristic banded or ridged surface ornamentation seen in *S. chartarum*.

ACKNOWLEDGMENT

We thank Dr. S. C. Jong, American Type Culture Collection, for reviewing the manuscript.

REFERENCE

JONG, S. C., and E. E. DAVIS. 1976. Contribution to the knowledge of *Stachybotrys* and *Memnoniella* in culture. Mycotaxon 3:409-485.

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NOTES ON COLORADO FUNGI II.
SPECIES OF *ARMILLARIA* (FR.) KUMMER. (AGARICALES)

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SUMMARY

The status of *Armillaria* and the tribe Biannulariae of the *Agaricales* is reviewed and revised. A key to the species of *Armillaria* section *Armillaria* is presented. *A. pitkinensis* sp. nov., *A. fusca* sp. nov., *A. straminea* var. *americana* f. *alba* comb. nov. are presented along with *A. albolanaripes* f. *alba* f. nov. The taxonomic value of divergent gill trama as a generic character in tribe Biannulariae and in genus *Armillaria* is questioned. The possibility that *A. straminea* var. *americana, A. fusca,* and *A. albolanaripes* in the central Rocky Mountain area hybridize to produce a "hybrid swarm" of variants is postulated.

INTRODUCTION

The abundant fruitings of the striking fungus known in our western states as "*Armillaria luteovirens* (Fr.) Saccardo" have attracted both the amateur and professional mycologist. The basidiocarps are conspicuous, have excellent flavor and are frequently collected for the table. In Colorado the species is clearly associated with aspen and in this habitat often occurs as a mushroom "weed." Several amateur collectors have for years been aware of variations in this species, but since all were found edible, little attention was paid to basidiocarp anatomy, and all were simply referred to as "Shaggy Stems." Our interest was stimulated by the changing status of *Armillaria luteovirens* in Europe and the placing of *Armillaria straminea* (Krombholz) Kummer in synonymy with it. In addition to our concern over the identity of *A. luteovirens*, we soon became interested in the related species as they were found here in the state. The present report consists of the results of our studies to date.

In working with this group it was tempting to postulate that we have three basic species in Colorado--*A. albolanaripes*, *A. fusca*, and *A. straminea* var. *americana*, and that the long series of variants discovered, including *A. pitkinensis*, represent hybrids between any two of the three basic species. It is this series that requires further critical study.

We have studied about 300 collections, but these were not all made in Colorado. Smith's collections at the University of Michigan Herbarium are from the western United States generally, and Charles Barrows encountered the genus frequently in the mountains of New Mexico and Arizona.

Color terms within quotation marks in our descriptions are taken from R. Ridgway (1912). Specimens are on deposit at the Denver Botanic Gardens (DBG), and the University of Michigan Herbarium (MICH) at Ann Arbor.

THE STATUS OF *ARMILLARIA LUTEOVIRENS* (ALB. & SCHW. EX FR.) KUMMER.

Singer, in his classification of the Agaricales (1951, 1962, 1975), made an attempt to save the genus *Armillaria* from obscurity by restricting the concept to species with amyloid spores. *Agaricus luteovirens* Albertini & Schweinitz was selected as the type (1951); in later works (1962, 1975) *Armillaria straminea* Krombholz was substituted, but it was indicated as a synonym of *A. luteovirens*. The situation was complicated by Pouzar (1957) who described the genus *Floccularia* based on *A. straminea* Krombh. The genus was placed in the Amanitaceae because of the bilateral hymenophoral trama. Singer (1975) incorporated the feature of bilateral gill trama in his tribe Biannulariae which includes, among other genera, his restricted concept of *Armillaria*. In other words, he accepted Pouzar's data of hyphal arrangement of the gill trama but did not agree with him as to the family in which the species belonged. He continued to maintain that *A. luteovirens* and *A. straminea* were synonyms. Since we first identified our Colorado collections as *Armillaria luteovirens*, and since Smith described the gill trama of North American collections as parallel (p. 355, 1949), and the same for form *alba* (1947), we were interested first in a restudy of the hyphal arrangement of the gill trama. Pilat (1969) reported f. *alba* (A. H. Smith) Pilat, and mentioned the bilateral lamellar trama. We could not be sure whether Pilat's observations were based on dried specimens of Smith's collections or on fresh material he collected. He studied both. We felt it very desirable to restudy the whole problem particularly on fresh material to clarify this feature relative to these species and their variants.

THE HYMENOPHORAL TRAMA OF *"ARMILLARIA LUTEOVIRENS"*

None of the collections we studied showed any trace of a bilateral arrangement of lamellar hyphae. Our detailed study was made on free-hand sections of fresh material mounted in water. We used lamellae from basidiocarps in all stages of development from unopened buttons in which the gills were incompletely formed to caps past maturity. Some specimens were dried and then revived and re-examined in mounts made in both Melzer's solution and in 3% KOH. Dried specimens from herbaria were similarly revived and examined. In all of these studies, the hyphae of the gill trama were parallel or practically so. We then investigated related species (all those in the key) and found the hyphal arrangement in the gill trama exactly comparable with that found for *"A. luteo-virens"*: no indication of bilaterality was observed. Fortunately, when Pouzar erected *Floccularia* he desigated as the type *Agaricus stramineus* Krombh. This then must be the species with the bilateral hymenophoral trama. It has not yet been discovered in either its typical or albino form in North America. Since Singer (1951) listed *Agaricus luteovirens* as the type of *Armillaria*, in an attempt to compare the original concept of this species with that of *A. straminea*, we consulted the original description by Albertini & Schweinitz--which we quote in part as follows:

> "483. A. G. luteo-virens nobis
> "A. G. subcaespitosus, pileo carnoso duro subflexuosa pulverulento sordide lutescenti-viridi, lamellis confertis angustis subliberis pallentibus, stipite solido crasso brevi sursum incrassato squamuloso toto albo."

A more detailed account follows in which the habitat is stated as "Amat sylvas acerosas sicciusculus sed parum frequens occurrit."

In the North American collections the pileus was in no way pulverulent (dusted), the consistency was not hard (duro), in no way can "sordide lutescente-viridi" be considered the equivalent of lemon to chrome yellow, and lamellae up to 12 mm broad cannot be interpreted as narrow (angustis). In short, we are forced to conclude that the original description of *A. luteo-virens* cannot, within reason, apply to our Colorado mushroom. Fries' (1821) description, which validates the name, in general follows the diagnosis of Albertini & Schweinitz, but is not the concept of current authors. It seems that the only way to settle the concept of this species is by designating a type according to the procedure proposed by Smith (1976, in press).

Romagnesi (1967, pl. 243, f. 4), under the name *Tricholoma luteo-virens,* gives a good illustration of our Colorado fungus, and one which passes rather well for *Agaricus stramineus* Krombholz (see the original plate of the latter author). Romagnesi's observations are especially pertinent to our problem: "...Peu d'espèces ont provoqué autant d' erreurs, certaines méme enormes, quant à sa position dans la classification." He comments further that the bilaterality of the hymenophoral trama does not resemble that of *Amanita* but is more like that of *Catathelasma.* In regard to *Catathelasma*, we have been able to easily and regularly demonstrate a transient stage of bilaterality in the trama of some of the North American collections. We conclude from Romagnesi's comments that his concept of *"Tricholoma luteo-virens"* is that of the same species for which Pouzar used the name *Floccularia straminea.* Obviously, he did not believe the hyphal arrangement he observed in the gill trama of this species to be a valid generic character of this group. We agree with this evaluation, and like Romagnesi, do not use it as Singer (1975) did, as the diagnostic feature of a tribe. The feature is not consistent in *Catathelasma*, and, we think, obviously an unreliable one as a unifying feature in *Armillaria*. On this basis, it is logical to cite *Agaricus stramineus* Krombholz as the type of the genus *Armillaria* and to remove *Agaricus luteovirens* from synonymy. We describe the North American collections of *A. straminea* as a variety differing from the type variety in lacking bilateral gill trama at any stage in the development of the lamellae. This may seem to be a naive solution but in our estimation is closer to reality than describing the American material as an autonomous species. If we were to follow the pattern of Singer's classification (1975), it would be necessary to describe a new genus for the North American taxa. We have not been able to study fresh material of *A. straminea* var. *straminea* and we accept the statements of those who have. We feel that the results obtained from the study of dried material would be inconclusive.

THE VEILS

In *A. straminea* var. *americana*, we found the veil to be composed of two different types of cells. On the upper canescent surface the cells were large, oval (inflated), thin-walled, and 50-70 x 25-30 µ (Fig. 1). On the inferior floccose surface they were long, slender, tubular and 80-100 x 6-10 µ (Fig. 2). Details on the other species are not as complete, but in *A. albolanaripes*, data from studies of dried material showed the bulk of the veil to be made up of tubular hyphae with little or no constriction at the septa. Clamps were regularly present, the cells were greatly elongated to over ten times as long as wide, and the walls were thin and smooth. In the other species studied to date, the hyphae were 75-200 x 4-12 µ, tubular and smooth-walled. In some variants as yet unclassified, we hazard the prediction that both single and "double" veils will be found in the North American species of *Armillaria* sect. *Armillaria*.

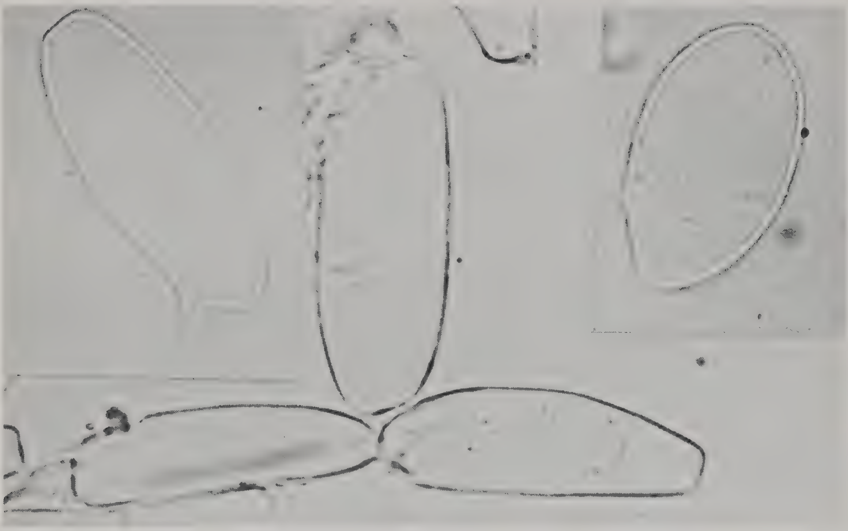

Fig. 1. Inflated cells from upper surface of veil of *A. straminea* var. *americana* x2000 Mitchel 5950

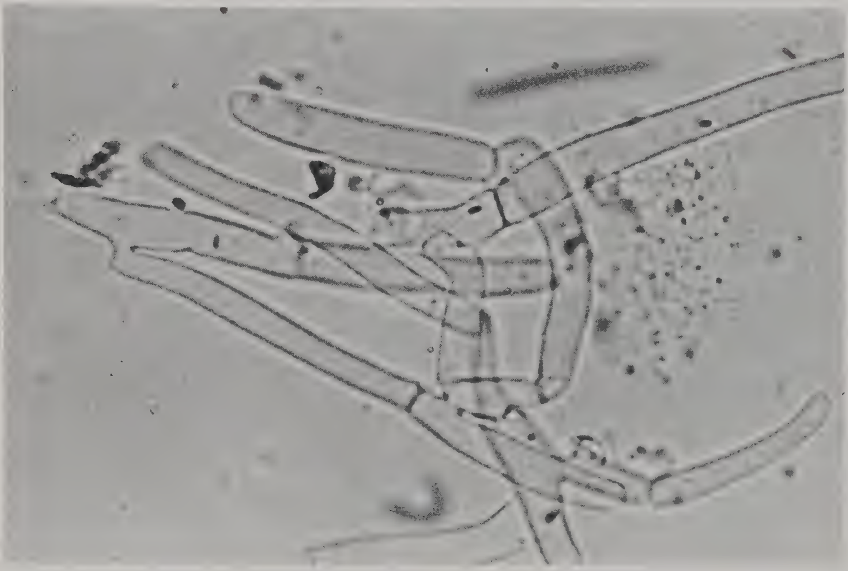

Fig. 2. Slender cells from lower surface of veil of *A. straminea* var. *americana* x2000 Mitchel 5950

PILEAR CUTICLE

In *A. straminea* var. *americana* and *A. fusca* the cuticle is of appressed ± radial hyphae which at intervals give off fascicles of similar hyphae that form the scales on the cap. In *A. fusca* a trichoderm is at first present and as it collapses a more or less glabrous surface with patches of appressed fibrils results. To say the least, the cuticle appears to be in a rather primitive stage of development. Characters of the cuticular hyphae of possible taxonomic significance are the degree to which the hyphae are narrowed at the cross-walls and the shape of the end-cells. The ratio of clamps per 100 septa (as a sample) may be found to be of limited value. The narrowing of the cells at the cross-walls, we believe, has some phylogenetic significance in reviewing the relationships of *Cystoderma* to other genera in tribe Biannulariae.

SYSTEMATIC CONSIDERATIONS

In view of our estimates of the value of some of the characters, and since these differ from the evaluations Singer employed in his system of classification, we present a tentative revision of the tribe Biannulariae and, in particular, the genus *Armillaria*.

The tribe Biannulariae: In Singer's (1975) classification this tribe is defined and keyed out primarily on the presence of bilateral gill trama. *Armillaria* is included with *A. straminea* as the type. In view of the questions we have raised relative to bilaterality of the gill trama in this group, we omit this feature as a major character. We include, in the present tentative revision of the tribe, the genera *Cystoderma, Catathelasma, Armillaria,* and marginally *Armillariella*.

For *Catathelasma* we emphasize the amyloid spores, large, heavy, persistent basidiocarps with hard white flesh at first, a distinct, usually double veil, and in most species, some divergence of hyphae near the subhymenium. The population of this genus in Colorado is relatively diverse and will be the subject of a forthcoming paper by us.

Armillaria: We define as a genus of white to whitish-spored species with stipe confluent with the pileus and gills attached (in various ways) to the stipe. A veil leaving a double annulus, or if annulus single or arachnoid (± a cortina) the spores amyloid. The pileus is never powdery or granulose as in *Cystoderma*. This definition excludes a number, but not all, of the species once placed in *Armillaria* but now placed in *Tricholoma* by some authors.

Cystoderma: Spores amyloid or not, veil basically double, outer layer granulose to powdery from sphaerocysts, stipe typically slender (in a few 12-20 mm thick) but continuous with pileus, cuticle of pileus usually reactive in KOH (turning cinnamon or olive). This genus is now placed in the Agaricaceae by Singer but its relationships appear to us to be here.

Armillariella: We do not insist upon this genus being a member of the tribe Biannulariae, but since Smith has observed some semblance of bilaterality in the hymenophore of *Armillariella mellea* ss. lato, and since the floccose veil appears in many collections to be double, in at least a rudimentary sense, we comment on it here. Its pattern of specialization relative to habitat, production of rhizomorphs, etc., certainly indicate a trend away from the other genera.

ARMILLARIA (FR.) KUMMER

Spore deposit white to whitish; pileus and stipe confluent; stipe centrally attached, lamellae adnate, adnexed or decurrent; annulus present as a membranous ring or floccose band; spores amyloid, or if inamyloid then annulus double; typically terrestrial and assumed to be mycorrhiza formers.

Type species *Armillaria straminea* (Krombh.) Kummer.

KEY TO SECTIONS

1. Spores amyloid, veil floccose, annulus not typically membranous . . . . .Sect. *Armillaria*

1. Spores inamyloid, annulus membranous and double. . . . . Sect. *Caligate**

SECTION *Armillaria*

KEY

1. Pileus conspicuously scaly with ± rusty brown scales; growing on hardwood logs, etc. . . . . *A. decorosa* (Pk.) Smith & Walters (extralimital)

1. Not as above. 2

    2. Basidiocarps white when young. 3

    2. Basidiocarps colored when young. 4

3. Pileus at first with recurved large scales. . . . . *A. straminea* var. *americana* f. *alba*

3. Pileus ± glabrous or with appressed fibrils . . . . *A. albolanaripes* f. *alba*

    4. Pileus with conspicuous recurved bright yellow scales, chrome yellow when fresh, fading to whitish, evenly colored; under aspen . . . . *A. straminea* var. *americana* f. *americana*

    4. Not as above 5

5. Pileus when fresh fuscous to gray; no yellow tints present . . . . *A. fusca*

5. Yellow tints present on some part of basidiocarp by maturity. 6

    6. Pileus margin bright yellow at maturity; cuticle of hyphae 4-10 μ wide, tubular and the cells not, or scarcely, constricted at septa; end-cells of elements tubular with blunt apices. . . . . *A. albolanaripes* f. *albolanaripes*

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*Sect. *Caligate* sec. nov. A typo differ: annulus duplex: sporae inamyloidae. Typus: *Armillaria caligata* Viv.

6. Pileus margin weakly colored (not bright yellow); cuticular hyphae with cells constricted at the septa and end-cells cystidioid or tapered to a subacute apex. . . . . *A. pitkinensis*

1. *Armillaria straminea* (Krombholz) Kummer, var. *americana* var. nov. f. *americana*

Agaricus stramineus Krombholz, Naturgetreue Abbildungen und Beschreibungen der essbaren, schädlichen und verdächtigen Schwamme; pl. 25, figs. 8-14, 1836. Illustrations: Fig. 3: Smith (1949) reel 32, no. 222, (1975) p. 143.

Pileus 4-18 cm latus, demum late umbonatus vel convexus siccus, sapor mitis; lamellae latae, adnatae, confertae, vel subdistantes, pallide lutae; stipes 5-12 cm longus, 1.2-2.5 cm crassus, saepe bulbosus (3 cm latus); vellum copiosum, floccosum; sporae in cumulo albae, (5) 6-8 x (3.7) 4-5 μ leviter amyloideae; trama lamellorum hyphis parallelis. Specimen typicum in Herbarium Denver Botanic Gardens conservatum est; legit prope West Village, Aspen, Colorado, 9 August 1975, Smith 85661 (DBG--6254).

Pileus 4-18 cm broad, obtusely conic to convex, becoming broadly umbonate to plane, surface dry, with conspicuous triangular scales, appressed-fibrillose at first but scales becoming tufted and recurved in age (up to 1 cm broad with recurved tips to 0.5 cm long), imbricate, arranged in concentric circles, surface of cap glabrescent in age; ground color "straw yellow" and scales varying from "lemon chrome" to "mustard yellow" and finally at times with orange-brown tips, fading in sun to whitish; margin incurved at first, becoming straight, appendiculate with remnants of yellow floccose veil. Context white except stained bright yellow to depth of 3-4 mm under cuticle, firm, up to 3 cm thick, odor and taste mild, KOH and $FeSO_4$ both negative.

Lamellae adnate to sinuate, moderately close, broad (to 12 mm), margins crisped and soon eroded to serrate, light yellow when young becoming pale lemon yellow in age, always lighter colored than pileus, not staining.

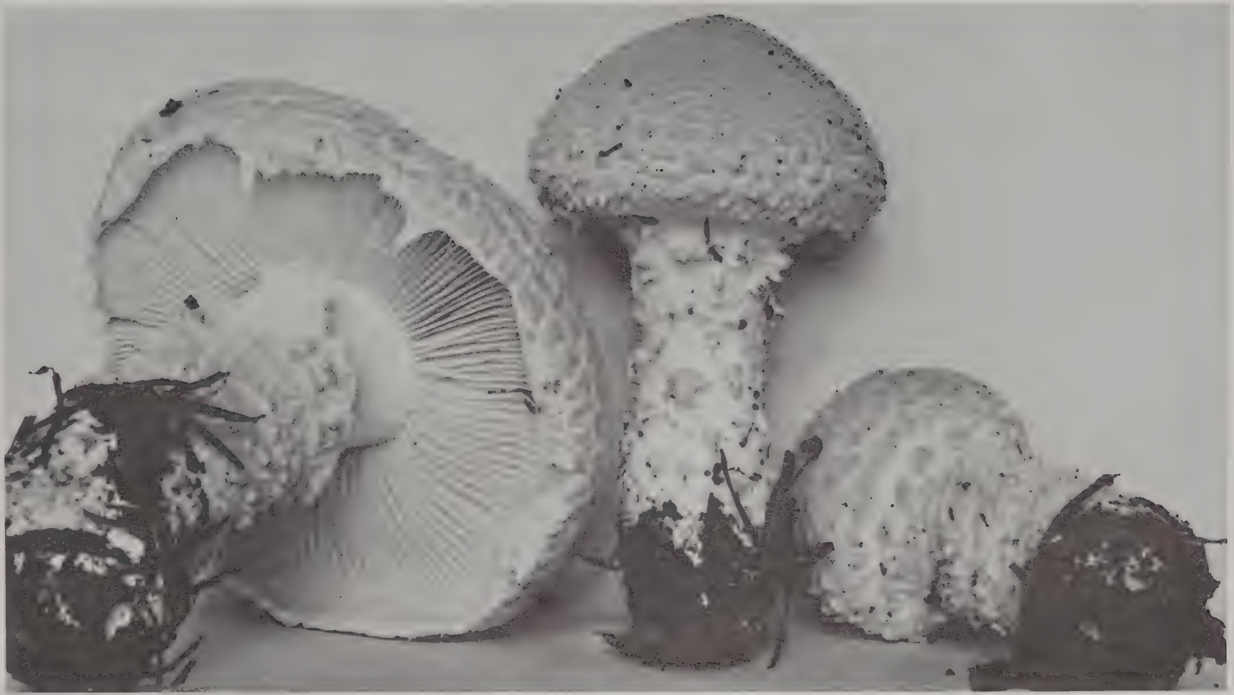

Fig. 3. *Armillaria straminea* var. *americana* f. *americana* x1 Smith 31216

Stipe 5-12 cm long, 1.5-2.5 cm thick, equal to expanding upward but often with a bulb up to 3 cm thick; smooth and white above the thick floccose veil, soon shaggy squamulose below from veil remnants; the scales concolorous with pileus and up to 5 mm long, arranged in concentric zones below annular zone; base not discoloring, solid to loosely stuffed with a white pith; cortex stained yellow to depth of 1 mm in area below annulus.

Spore deposit white. Spores (5) 6-8 x (3.7) 4-5 µ. Cystidia none. A few dextrinoid basidioles scattered in hymenium. Lamellar trama parallel, hyphae thin-walled, tubular, the cells 30-45 x 10-15 µ and rectangular in optical section. Clamps present. Cuticle of pileus of long filamentous hyphae united in places into semi-erect fascicles, cells 80-150 x 8-15 µ, very little constriction at cross-walls, clamps infrequent. Yellow pigment soluble in alcohol, water, and KOH and soon breaking down where exposed to sunlight.

Habit, habitat and distribution: In aspen groves with scattered alder and maple, common most years at elevations of 7,000 to 9,000 feet during the summer rainy period.

Observations: No collections were found that showed any intergradation with *A. albolanaripes* but Miller's (1972) pl. 107 may be such a variant.

Material cited: COLORADO: Barrill 18; Hesler 12684; Mitchel 1307 (A), 2430, 2803, 3794, 4116, 5111, 5300, 5949, 5950, 5974, 5975, 6129, 6130; Smith 85140, 85847. WASHINGTON: Smith 31216. WYOMING: Solheim 3522, 3558.

2. *Armillaria straminea* var. *americana* f. *alba* comb. nov.

Armillaria luteovirens f. *alba* Smith, Mycologia 39:625, 1947, *Flocculaţria luteovirens* (Alb. & Schw. ex Fr.) Pouzar f. *alba* (A. H. Smith) Pilat.

This variant is similar to var. *americana* f. *americana* in all features with the exception that it is white throughout.

3. *Armillaria albolanaripes* Atkinson, Annales Mycol. 6:54, 1908, f. *albolanaripes*

Illustrations Fig. 4. Smith, 1975, pl. 145; and 1949, reel 15, no. 104.

Pileus 4-12 cm broad, convex to obtuse, expanded to broadly umbonate-convex, plane or the margin turned up slightly, surface slightly tacky, soon dry, disc innately fibrillose with patches of appressed fibrils or squamules toward the margin, distinctly scaly in age at times; edge decorated with loose patches from the broken veil; color at first bright yellow ("yellow chrome") over disc, margin paler to whitish, disc gradually becoming cinnamon brown to bister or blackish as do the squamules, ground color over margin becoming bright yellow in age if whitish at first. Context about 2 cm thick on disc, tapered evenly to margin, with a narrow yellow band under the cuticle, remainder white, firm; odor none, taste none.

Lamellae close, deeply depressed-adnate to nearly free, close, white, moderately broad, edges uneven to eroded, not staining where injured.

Stipe 2-8 cm long, 9-25 mm thick, equal or either enlarged or narrowed downward, stuffed by a compact white pith; lower half sheathed by the torn, somewhat fibrillose, scaly remains of an outer veil, squamules white with yellowish or brownish tips, at times squamules in concentric zones; annulus membranous to fibrillose, lax; stipe above annulus smooth and white at first, flushed yellowish in age.

Spore deposit white. Spores 6-8 x 4-5 µ, ellipsoid, smooth, thin-walled, weakly amyloid (best seen on spores from prints ± 40 years old). Basidia 4-spored, clavate, 23-34 x 5.5-8.5 µ. Pleuro- and cheilocystidia not observed. Gill trama of a central interwoven strand of cells somewhat inflated, this region flanked by bands of parallel tubular hyphae to the indistinct subhymenium (no sign of diverging hyphae). Pileus trama of intricately interwoven hyphae with cells ± enlarged and 10-18 µ in diameter, walls thin and smooth. Pileus cuticle of ± radial, tubular, long slender hyphae (150-200 x 8-10 µ), the layer colored diffusely (under microscope), the cell walls at most faintly

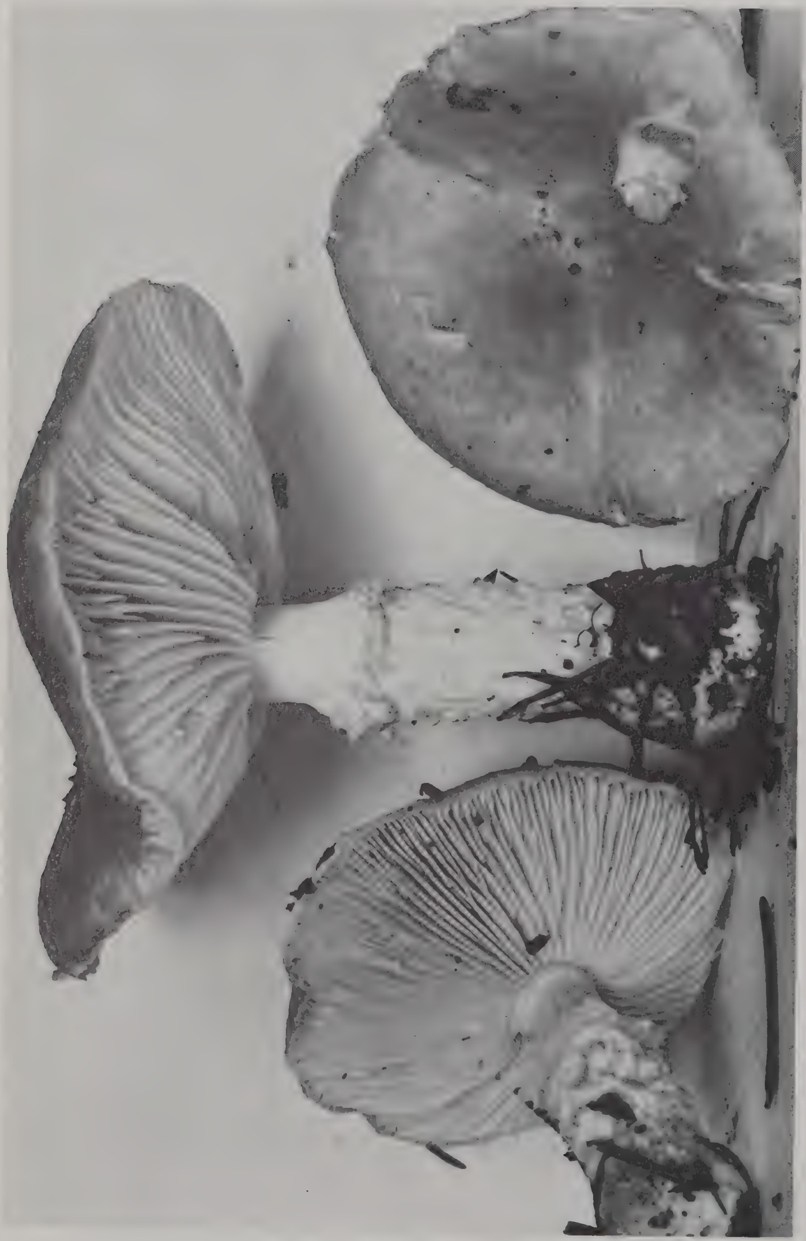

Fig. 4. *Armillaria albolanaripes* f. *albolanaripes* x1 Smith 17036

ochraceous, not constricted at the septa. Clamps present but infrequent.

Habit, habitat and distribution: Scattered to gregarious under conifers, western USA, summer and fall, not uncommon.

Observations: This is a variable species but the pileus cuticle is constant in its characters--the hyphae are loosely radially arranged, long, straight and tubular, 5-12 µ in diameter, with clamps at the cross-walls, and no significant pigment in the cell walls. The spores are weakly amyloid in most collections, and there is no sign of divergence in the gill trama. The species features bright yellow pigments in the pileus, especially the margin at maturity.

Material cited: COLORADO: Mitchel 6155, 6164. IDAHO: Smith 76160, 76552. NEW MEXICO: Barrows 152. WASHINGTON: Smith 2840, 17036.

4. *Armillaria albolanaripes* f. *alba* f. nov.

A typo differt: pileus albus tarde demum pallide argillaceus; vellum sparsum, albidum. Specimen typicum in Herbarium Denver Botanic Gardens conservatum est; legit August 1961, prope Bull Creek, New Mexico, Barrows 1299.

The status of this variant is not entirely clear as yet since the basidiocarps slowly became alutaceous as they dried and the veil is thin. We take this occasion to place the variant on record. We have an additional record from Colorado, Mitchel 6132.

5. *Armillaria fusca* sp. nov.

Illustration. Fig. 5.

Pileus 4-7 cm latus, obtusus, demum convexus, glaber, udus, subhygrophanus, fuscus vel pallidior, ad marginem albo-appendiculatus; odor nullus, sapor mitis; lamellae confertae, latae, anguste adnatae, sordide albae; sporae 6-8 x 4-5 µ, leves, amyloideae. Specimen typicum in Herbarium Denver Botanic Gardens; legit prope Eagle, Colorado,

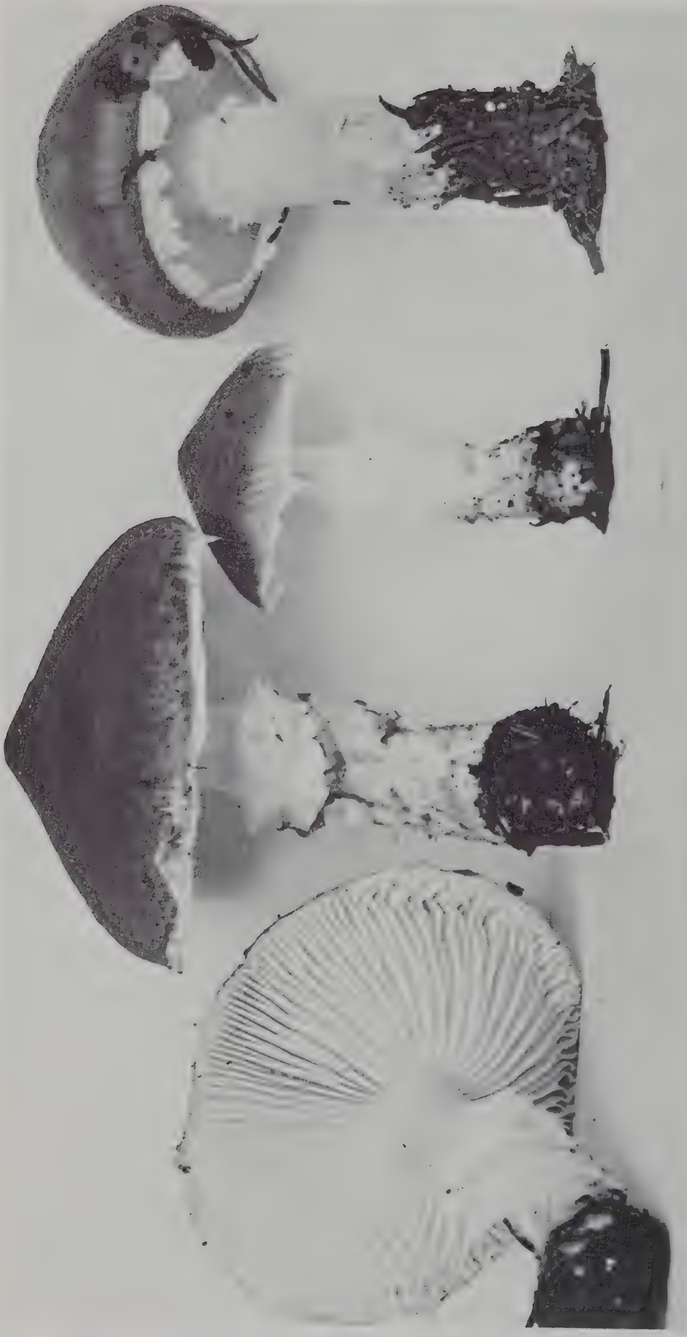

Fig. 5. *Armillaria fusca* x1 Smith 51601

2 August 1967, Mitchel 1307 B.

Pileus 4-7 cm broad, obtuse to convex becoming plane or nearly so, surface moist, subhygrophanous, glabrous when young but with streaks of appressed fibrils in age as ground color becomes paler, "olive brown" to "wood brown" (more or less fuscous over all); margin opaque at all times and usually appendiculate with white veil remnants, in age becoming slightly squamulous as the fascicles of fibrils recurve slightly at their tip. Context white, soon riddled by larvae, not darkening around tunnels, odor slight, taste mild; KOH on cuticle not distinctive; $FeSO_4$ no reaction.

Lamellae close, broad, adnexed (deeply so at times), dull white to flushed with gray in age (lacking yellow tints), edges even to serrulate, not staining where injured.

Stipe 6-7 cm long, 10-15 mm thick, equal, solid but soft within; surface floccose below the ragged annular zone, the veil remnants pallid or finally grayish buff, silky and pallid near apex.

Spore print white; spores (5.5) 6-8 (9) x (3.7) 4-5 µ, smooth, thin-walled, hyaline, ellipsoid, often with central oil drop, strongly amyloid.

Basidia 23-30 x 6-8 µ, usually 4-spored. Cystidia lacking. Dextrinoid basidioles scattered in the hymenium. Lamellar trama parallel, cells 20-30 x 8-15 µ, not inflated except in region of central core. Cuticle of pileus of tubular hyphae becoming appressed, cells of hyphae of variable length in the epicutis, mostly medium-long (100-150 x 8-12 µ), with numerous cross-walls, clamps present but rare.

Habit, habitat and distribution: Solitary to scattered under spruce, Colorado, summer rainy season.

Observations: This species features a fuscous to cinereous pileus which is glabrous to inconspicuously squamulose from appressed squamules, and a lack of yellow tints in the basidiocarps. The intensity of the color may vary from dark (in some collections the buttons are nearly black) to light (two collections are nearly white) but the hue stays the same--a smoky gray without yellow tints. These features distinguish it from *A. pitkinensis*. Both appear to be distinctive features of the agaric flora of the central and southern Rocky Mountains.

Material cited: COLORADO: Mitchel 2101, 3972, 5777, 5966, 6133; Smith 51601, 85888, 85915, 85916.

6. *Armillaria pitkinensis* sp. nov.

Illustrations. Fig. 6.

Pileus 4-10 cm latus, demum subplanus, viscidulus, pallide subochraceus ad; centrum avellaneo-virgatulus, ad marginem appendiculatus; sapor mitis, odor nullus; lamellae luteolae, latae, confertae, sinuatae; stipes 3-7 cm longus, 0.5-2 cm crassus, sursum albidus deorsum squamulosus, squamulae parvae, griseoluteolae; annulus membranaceus, sursum albus, subtus squamis cinereoluteolis; sporae in cumulo albae, 6-8 x 4-5 μ, amyloideae. Specimen typicum in Herbarium Denver Botanic Gardens conservatum est; legit prope West Village, Aspen, Pitkin County, Colorado, 20 August 1975, Smith 85889.

Pileus 4-10 cm broad, obtuse to convex, finally plane, when young slightly viscid, smooth at first, shiny when dry, cuticle breaking up into appressed imbricate fibrillose squamules, ground color pale dingy yellow to ivory-yellow or brownish, squamules pinkish-gray ("avellaneous") to "wood brown" (slightly darker) on disc; margin incurved at first, becoming straight in age, typically appendiculate with ragged remnants of the veil. Context white, no discoloration around worm tunnels, odor and taste not distinctive, no color change where bruised, $FeSO_4$ more or less cinnamon; with KOH no distinct reaction.

Lamellae white, becoming dingy yellowish and drying yellowish, not staining where bruised, close, moderately broad, adnexed, edges eroded.

Stipe 3-7 cm long, 0.5-2 (2.5) cm thick, equal to slightly clavate, bulb small, loosely stuffed with a white pith; surface smooth and white above the veil, more or less covered below with dingy pale yellow to grayish-yellow squamules or zones of veil tissue, basal mycelium

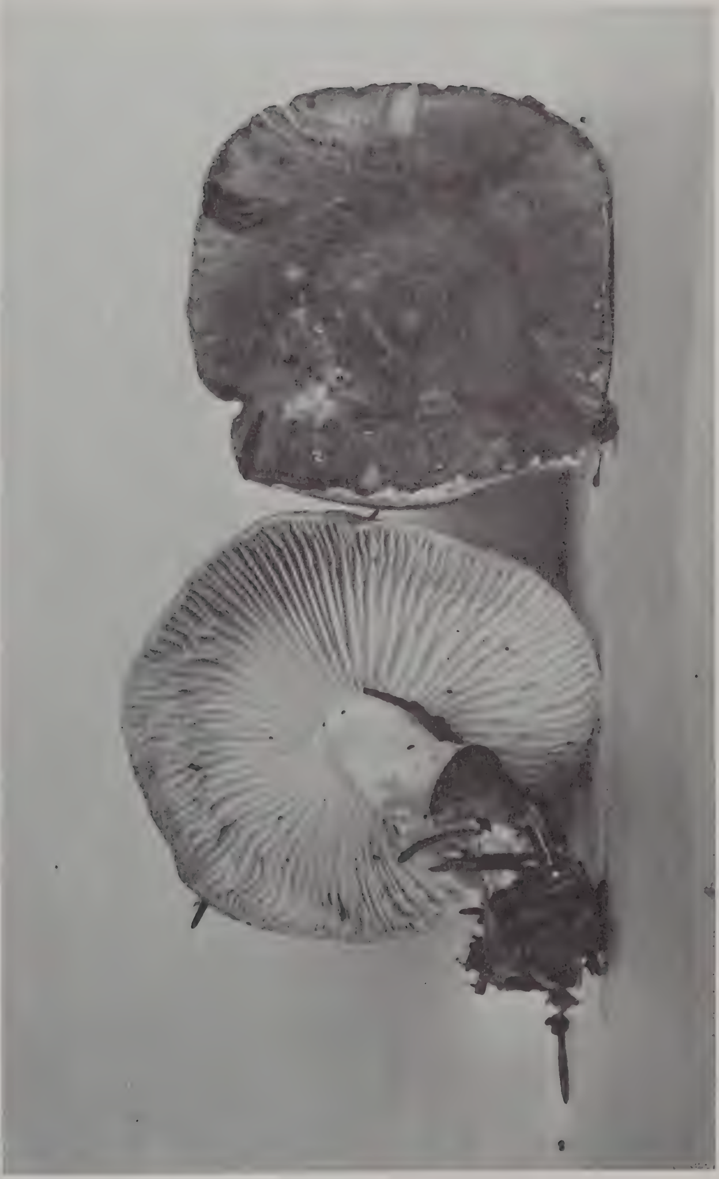

Fig. 6. *Armillaria pitkinensis* x1 Smith 52513

white.

Spore deposit white; spores 6-8 x 4-5 µ, smooth, thin-walled, hyaline, ellipsoid, amyloid.

Basidia clavate, 4-spored, (20) 23-28 x 6-8 µ. Dextrinoid basidioles scattered in hymenium. Cystidia none. Lamellar trama of parallel hyphae, the cells 40-50 x 15-20 µ, tubular. Cuticle of pileus an intermittent trichoderm, the elements of which soon become appressed to the cap surface as fibrils, the cells of the elements constricted at the septa, cells 90-125 x 12-15 µ. Clamps present.

Habit, habitat and distribution: Scattered under conifers (spruce and fir), Colorado, after summer rains, not common.

Observations: The habitat appears to be specialized. Near Ashcroft in a grove of aspen with scattered old spruce trees, this species was found only on the piles of old cones and needles. In the pileus considerable color variation was noted--olive buff, dull pale yellowish, pale buff to vinaceous buff, and often gray tones developing in age or on drying--either on cap or stipe or both. This species appears to be the nearest to *Agaricus luteo-virens*, as the latter was originally described, of any North American material seen. The manner in which the cells of the cuticular elements are constricted at the cross-walls reminds one, to a degree, of *Cystoderma*.

Material cited: COLORADO: Mitchel 2856, 5938, 6126, 6128, 6135, 6138, 6156, 6275, 6276, 6300, 6301, 6439; Smith 52513, 85772, 85839. IDAHO: McKnight F887; Weber 3414. NEW MEXICO: Barrows 241, 261, 556, 575, 1293, 1504, 1731; Isaacs 2650.

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NOTICES

SECOND INTERNATIONAL MYCOLOGICAL CONGRESS 1977

The Second and Final Circular describing the Second International Mycological Congress has been distributed to those persons responding to the first circular. The circular describes the symposium portion of the program, the format for contributed papers, events to occur during the Congress, and accommodations at or near the University of South Florida. Anyone interested in learning more of, or participating in the Congress should write:

Dr. Melvin S. Fuller
Secretary IMC^2
Department of Botany
University of Georgia
Athens, GA 30602 USA

AUGUST 27 to SEPTEMBER 3, 1977

UNIVERSITY OF SOUTH FLORIDA
TAMPA, FLORIDA

BELTSVILLE SYMPOSIUM II:
BIOSYSTEMATICS IN AGRICULTURE

In 5 symposium sessions leading investigators will lecture or engage in panel discussions on the role that biosystematics has in agriculture. Main topics will include new techniques, taxonomic theories, uses of taxonomic and biosystematic data, especially predictive applications, and the planning and direction of biosystematic research. In addition, a poster session and mixer is scheduled for the evening of May 9. Manned displays at the mixer should generate valuable discussion.

For further information send your name and address to:

Dr. James A. Duke
Publicity Committee, BARC Symposium II
Plant Taxonomy Laboratory
Room 117, Bldg. 001, BARC West, USDA
Beltsville, Maryland 20705 USA

MAY 9-11, 1977

MYCOTAXON

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A NEW SPECIES OF EMERICELLA

SHUN-ICHI UDAGAWA AND YOSHIKAZU HORIE

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Japan

In 1974, one of us (S.U.) had the opportunity to study the natural occurrence of mycotoxin-producing fungi in various parts of Malaysia and Thailand. On this occasion we found an Emericella which differed in several microscopic characteristics from E. rugulosa (Thom & Raper) C.R. Benjamin and also from all other species of Emericella described so far (Raper & Fennell, 1965; Wiley & Simmons, 1973; Samson & Mouchacca, 1974, 1975). Therefore, it is described below as new.

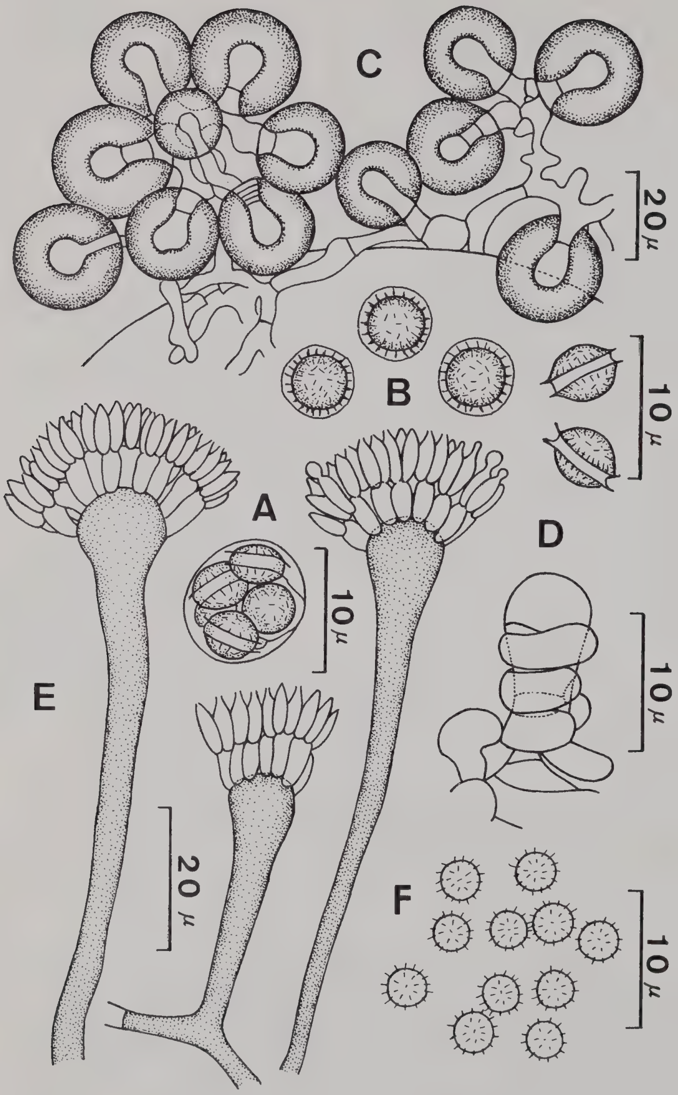
Specimens cited are deposited as follows: No. 2763 (holotype) in the Mycological Herbarium, National Institute of Hygienic Sciences (NHL), Tokyo, Japan, and No. 4522 (isotype) in the Mycological Herbarium, Research Institute for Chemobiodynamics (IFM), Chiba University, Narashino-shi, Chiba, Japan.

Emericella corrugata Udagawa & Horie sp.nov. (Figs. 1-2)

Status conidialis: Aspergillus corrugatus Udagawa & Horie st.nov.

Coloniae in agaro Czapekii fere celeriter crescentes, basi coactae, floccosae, dilute fulvae vel obscure flavovirides; cleistothecia abundanter producentia; fructificationes conidiorum limitatae; reversum valde rubro-brunneum. Coloniae in agaro maltoso effusae, planae, obscure flavae vel olivaceae vel griseo-olivaceae, cum mycelio aerio limitatae sed cleistotheciis abundanter producentes; fructificationes conidiorum aliquantum numerosae; reversum valde flavo-aurantiacum.

Cleistothecia valde purpurea, globosa vel subglobosa, plerumque 100-240 µm diam., cum numerosis cellulis "hülle" incrustata. Asci octospori, globosi vel ovati, 9-12 x 9-9.5 µm, catenulati, evanescentes. Ascosporae purpureo-rubrae, lenticulares, duabus cristis praeditae, 3.5-4.5 x 3.5-4.0 µm (sine cristis), paginis convexis irregulariter rugosis (canaliculatis). Cellulae "hülle" hyalinae, globosae vel subglobosae, 12-30 µm diam. Capitula conidiorum


C
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radiantia vel columnaria. Conidiophora vulgo e aeriis hyphis exorientia, (20-)45-140(-200) x 3.5-5.5 µm, sinuosa, interdum septata, rubro-brunnea, glabra, satis crassa. Vesiculae lageniformes, 9-12(-14) µm diam., in summa parte fertiles. Metulae 5-8 x 2.5-4 µm. Phialides ampulliformes, 6-7(-8) x 2.5-3.5 µm. Conidia globosa vel subglobosa, 2.5-3.5 µm diam., echinulata, dilute flavovirentia.

Typus No. 2763, NHL, isolatus e solo in thailandensis.

Cleistothecia dark purple, globose to subglobose, mostly 100-240 µm in diam., produced within dense masses of thick-walled hülle cells; peridium thin, consisting of several layers of yellowish encrusted hyphae, at maturity darkened and somewhat coriaceous. Asci 8-spored, globose to ovate, 9-12 x 9-9.5 µm, produced in chains from croziers, early deliquescent. Ascospores purple-red, lenticular, with two conspicuously pleated equatorial crests, 3.5-4.5 x 3.5-4.0 µm (crests 0.5-1.0 µm excluded), with convex surfaces irregularly wrinkled (with numerous grooves scattered when observed by scanning electron microscope). Hülle cells hyaline, globose to subglobose, 12-30 µm in diam. Conidial heads radiate to columnar. Conidiophores mostly arising from aerial hyphae as short side branches, (20-)45-140(-200) µm in length and 3.5-5.5 µm in diam. at middle, sinuous, sometimes septate, reddish brown, with walls smooth, fairly thick. Vesicles flask-shaped, 9-12(-14) µm in diam., fertile over the upper one-half to two-thirds. Metulae 5-8 x 2.5-4 µm. Phialides flask-shaped, 6-7(-8) x 2.5-3.5 µm, with a distinct collarette. Conidia globose to subglobose, 2.5-3.5 µm in diam., echinulate, yellowish green in masses.

At 37 C, growth better than at 25 C and with increased production of cleistothecia and conidial structures.

Holotype - No. 2763, NHL, isolated from soil sample in sugar-cane field, Nakorn Pathom, Thailand, December 15, 1974. Isotype - No. 4521, IFM.

Other material examined - No. 4522, IFM, isolated from soil from the same cultivated site, December 15, 1974.

The new species superficially resembles E. rugulosa (Thom & Raper) C.R. Benjamin (Raper & Fennell, 1965) but differs in its ascospore ornamentation. The convex walls of the ascospores are irregularly wrinkled by scattered grooves, in contrast to the closely reticulate walls in E. rugulosa (Locci, 1972; Fig. 2). E. nidulans var. echinulata Godeas (1972), the only other species of Emericella with similar ascospore color and markings, is differentiated from our species in having the convex surfaces echinulate rather than wrinkled (Fig. 2).

Figure 1. Emericella corrugata. A. Ascus. B. Ascospores. C. Hülle cells. D. Ascocarp initial. E. Conidial structures. F. Conidia.

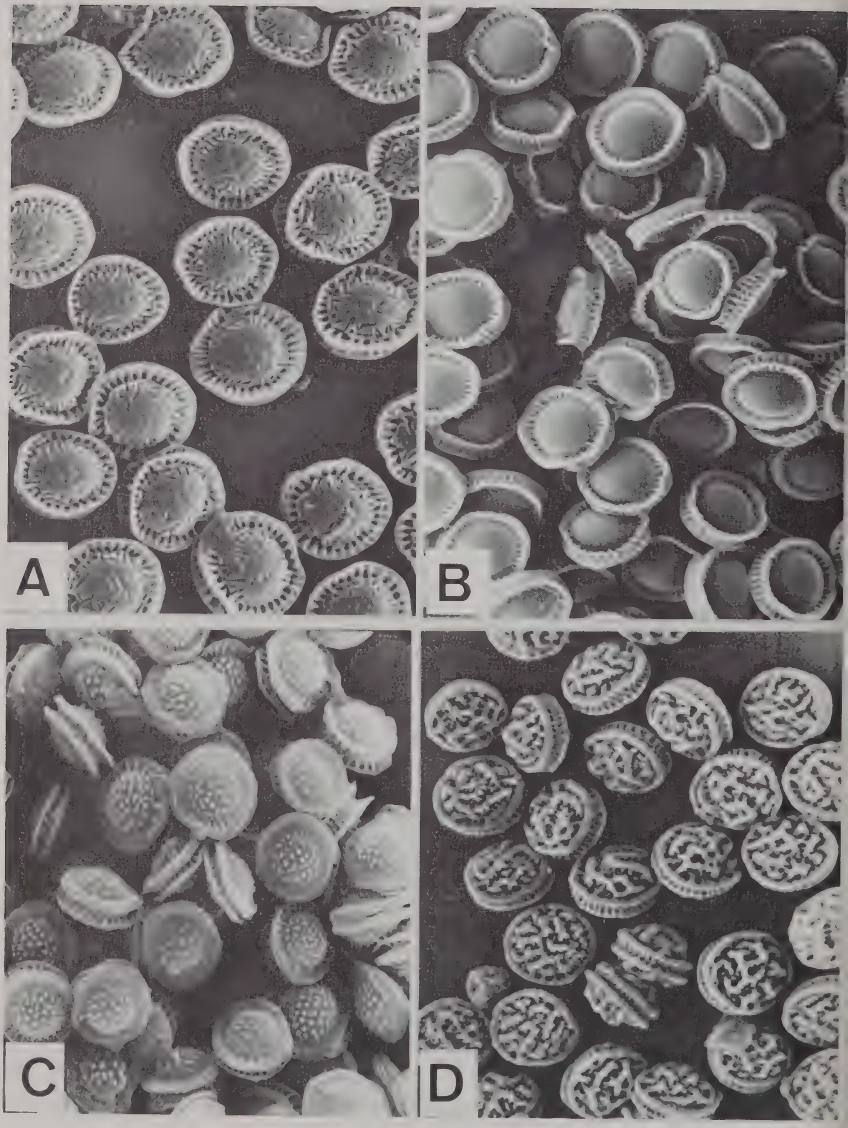

Figure 2. SEM photographs of ascospores of _Emericella_ spp. A. _E. corrugata_. X 23,000. B. _E. nidulans_ var. _nidulans_. X 20,000. C. _E. nidulans_ var. _echinulata_. X 20,000. D. _E. rugulosa_. X 23,000.

ACKNOWLEDGMENTS

The authors thank Professor David Malloch, Department of Botany, University of Toronto, for reading the manuscript and making helpful suggestions.

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MYCOTAXON

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UN CORDYCEPS NOUVEAU DES PYRÉNÉES FRANÇAISES: CORDYCEPS ROUXII SP. NOV.

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RÉSUMÉ

Ce *Cordyceps* parasite d'*Elaphomyces variegatus* Vitt. est récolté depuis 1974 en Juin-Juillet, sous *Fagus*, à 1000 m d'altitude, dans la région de Pau (Pyrénées Atlantiques) par le Docteur Guy ROUX à qui nous dédions; il appartient aux "Directae-Valliformes-Mediae."

SUMMARY

This *Cordyceps* parasitic on *Elaphomyces variegatus* Vitt. has been collected since 1974 in the months of June and July, under *Fagus*, at 1000 m elevation, in the Pau region of France (Pyrénées Atlantiques) by Dr. Guy ROUX to whom we dedicate it; it belongs to the "Directae-Valliformes-Mediae" group.

Dans un travail précédent publié dans le Bulletin de la Société Mycologique du Béarn (Candoussau, 1975) nous avons identifié la récolte de Juillet 1974 à *Cordyceps japonica* Lloyd pensant à des carpophores mal développés, mais deux nouvelles récoltes en 1975 et 1976 nous ont fait revenir sur cette détermination ainsi que des études complémentaires, en particulier de la structure des carpophores ont confirmés qu'il s'agissait bien d'une nouvelle espèce.

CARACTÈRES MACROSCOPIQUES

Stroma solitaire ou rarement par deux, distinctement capité, s'élevant directement de l'hôte, 3 à 6 cm de hauteur. Partie fertile du carpophore ronde ou semi globuleuse brun-noir (Séguy 706) brillante et visqueuse d'un diamètre de

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[1] *A cooperating scientist of the Plant Pathology Herbarium, Cornell University, Ithaca, NY 14853, USA.*

0,6 à 1,2 cm; ostioles légèrement proéminentes sous la couche gélifiée. Stipe cylindrique droit ou flexueux, sillonné longitudinalement, blanc teinté de gris vers le haut et parfois d'olivacé dans la partie inférieure, 0,2-0,8 cm de diamètre (FIGS. 1, 2).

CARACTÈRES MICROSCOPIQUES

Sous le microscope en coupe verticale (FIG. 3) le cortex laisse paraître un peridium sombre et pseudoparenchymateux couvert d'une couche superficielle de 20 µm environ d'épaisseur, de teinte plus claire et nettement différentiée: structure caractéristique du groupe "Valliformes." Perithèces ovoïdes (FIG. 4), 400-500 × 200-280 µm. Thèques (FIG. 5) 250-320 × 7-10 µm. Fragments sporaux fusoïdes (FIG. 6), (13-) 16 (-21) × 2,5-3 µm.

HABITAT

Sur *Elaphomyces variegatus* Vitt. Récoltes Guy ROUX: Juillet 1974 - 22 Juin 1975 - 3 Juillet 1976. *Station:* Bois de Haouquère près du Plas des Asphodèles, altitude 1000 m, exposition Sud. Région PAU, Pyrénées Atlantiques, France.

Il est à noter que l'apparition de ce *Cordyceps* ce situe depuis trois ans toujours à la même période et coïncide avec la croissance au même endroit sous *Fagus* des champignons

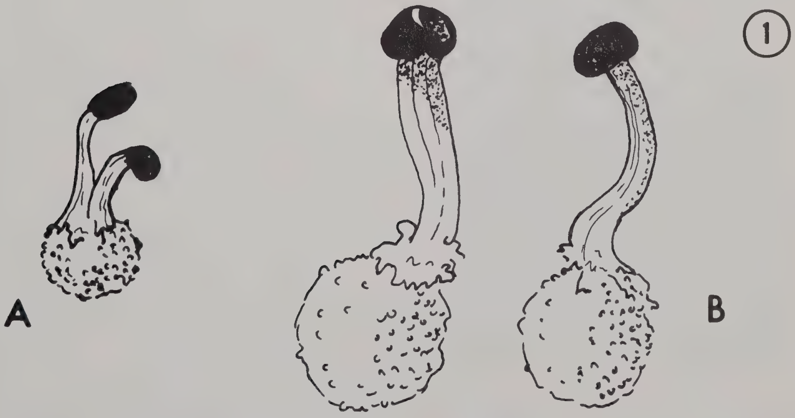


FIG. 1. *Cordyceps rouxii*. A. Récolte Dr. Guy ROUX - Juillet 1974 (Candoussau, 1975). Bois de Haouquère. (CUP 54948). B. Récolte Dr. Guy ROUX - 22 Juin 1975. Bois de Haouquère, /s *Fagus*, 1000 m alt. (CUP 54934).

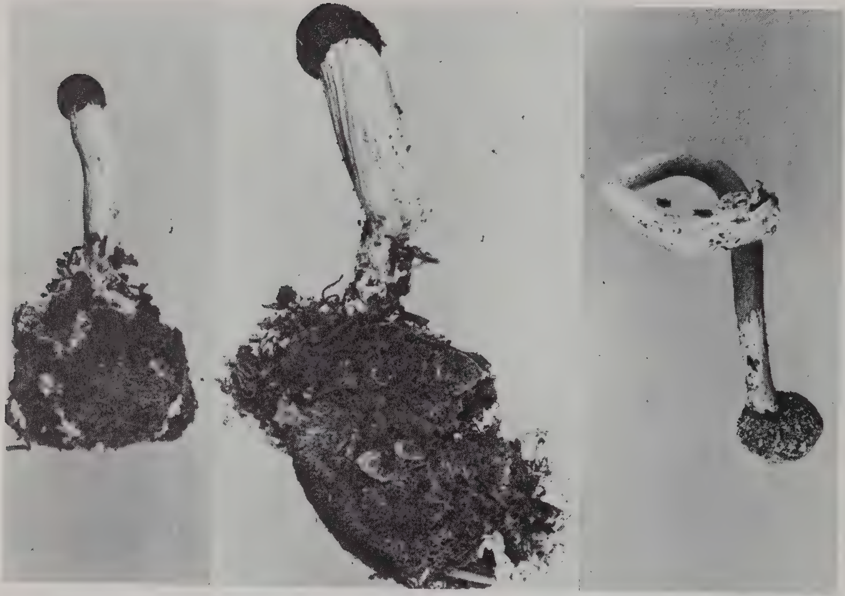


FIG. 2. *Cordyceps rouxii*. Récolte Dr. Guy ROUX - 3 Juillet 1976, même station que Fig. 1. (CUP 54937, HOLOTYPE). Photographies × 2.

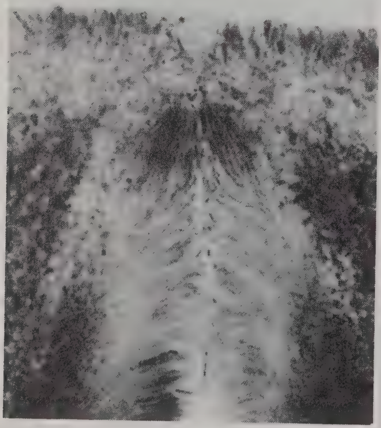


FIG. 3. *Cordyceps rouxii*. Coupe verticale du cortex de la partie fertile du carpophore, × 500. (CUP 54934).

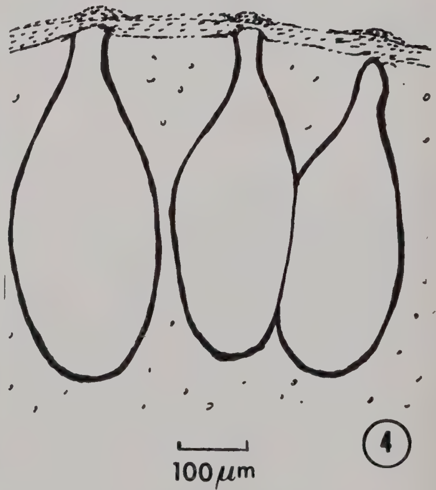
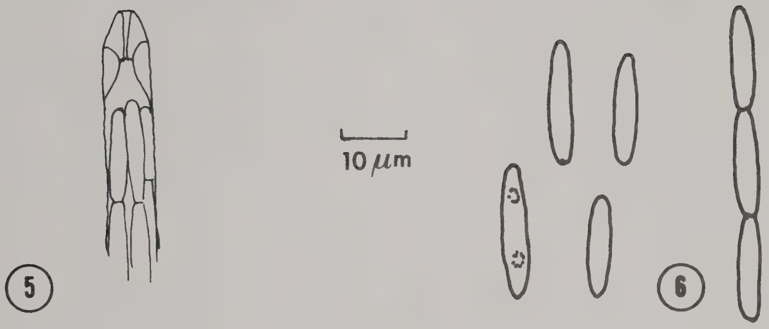


FIG. 4. *Cordyceps rouxii*. Coupe médiane de la partie fertile du carpophore (magnification indiquée). (CUP 54934).



FIGS. 5, 6. *Cordyceps rouxii*. 5. Extrémité de thèque mûre. 6. Segments sporaux. (Magnification indiquée).

suivants: *Pleurotus ostreatus* Jacq., *Russula cyanoxantha* Sch., *Marasmius aliaceus* Jacq., *Mycena alcalina* Rick, *Agrocybe praecox* Pers.

POSITION TAXONOMIQUE

Depuis que la structure des *Cordyceps* parasites d'*Elaphomyces* a été étudiée par Y. Kobayasi et D. Shimizu (1960) nous considérons qu'il éxiste deux groupes bien distincts: les Valliformes et les Evalliformes selon que la partie fertile des carpophores possède un cortex différentié ou non.

De ce fait notre récolte se situe dans *les Valliformes*. De plus les carpophores ne possédant pas de rhisomorphes abondants et superficiels tels que ceux de *C. ophioglossoïdes* par exemple, mais naissant directement de l'*Elaphomyces* notre *Cordyceps* sera classé dans les *Directae-Valliformes* et enfin considérant les mesures sporales qui se situent dans les moyennes 10-16 × 2,5-3 µm données par les auteurs Japonais, il prendra place dans les *Mediae*. Parmi les onze espèces décrites dans la monographie de Kobayasi et Shimizu aucune encore n'a été faite dans les "*Directae-Valliformes-Mediae*," la nôtre est donc la première.

Nous pouvons cependant comparer notre récolte aux deux autres à tête capitée comme la nôtre, du groupe Valliformes:

- *C. intermedia* Imai, spores 3-6 × 1,5-2 µm, section *Minutae*, sur *E. subvariegatus* et *E. cervinus*, Sept.
- *C. canadensis* Ell. et Everh., spores (21-) 30-50 (-60) × 3-5 µm, section *Magnae*, sur *E. granulatus* et *E. reti-*

culatus, Juin et Sept., régions subalpines. Si le stipe de ces deux *Cordyceps* est sensiblement plus long: 10-11 cm, la tête des carpophores est de même taille: 0,6-1 cm env. elle diffère par sa couleur soit brun rougeâtre chez *intermedia* et orangée chez *canadensis*.

C. canadensis semble avoir un habitat et une date d'apparition proches de notre espèce.

Quant à la couch gelifiée du cortex elle est d'une épaisseur de 21-27 µm chez *C. intermedia* Imai
de 8-12 µm chez *C. canadensis* Ell. & Everh.
de 20 µm chez *C. rouxii* F. Cand.

Les mesures sporales séparent les 3 nettement.

Aucune des espèces décrites par Mains (1957) ne correspond à la nôtre.

REMERCIEMENTS

Notre reconnaissance au Professeur R. P. KORF pour l'aide qu'il nous a apportée dans l'étude de ces récoltes. Tous nos remerciements à Susan C. GRUFF d'avoir fait pour nous les coupes verticales et à H. H. LYON d'avoir photographié les carpophores et les coupes verticales.

DIAGNOSE LATINE

Cordyceps rouxii Françoise Candoussau, species nova

Stromata solitaria vel caespitosa duo 2-4 cm alta directe fructificatione *Elaphomycetis variegatis*. Pars fertilis globularis 3-8(-10) mm, peridio fusco atro nitente viscoso, valliformi. Perithecia medium immersa, minuta, ovoidea collis plusve minusve elongatis 400-500 × 200-280 µm. Asci 250-320 × 7-10 µm capitibus circa 8-10 µm diam. Articuli ascosporarum cylindracei (13-) 16 (-21) × 2,5-3 µm utrinque fusiformi. HOLOTYPUS, CUP 54937; ISOTYPUS, Herbier F. Candoussau 4789-1.

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MYCOTAXON

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COPROTIELLA, A NEW CLEISTOCARPOUS GENUS OF THE PYRONEMATACEAE WITH ASCOSPORES POSSESSING de BARY BUBBLES[1]

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SUMMARY

Coprotiella gongylospora gen. et sp. nov. is described and illustrated from horse dung collected in Argentina. The genus is compared with Coprotus, its operculate counterpart. Cleistothelebolus, Eoterfezia, Lasiobolidium, Microeurotium, Orbicula, Warcupia and Xeromyces are transferred to the Pyronemataceae.

INTRODUCTION

In the course of a continuing study of coprophilous fungi, one apparently undescribed cleistocarpous genus was found growing on horse dung, collected in Argentina and maintained in moist chamber at room temperature. This taxon is characterized by possessing light coloured cleistothecia; broadly clavate asci; and hyaline, smooth, thin-walled ascospores possessing de Bary bubbles. Since no other cleistocarpous genus is known with this combination of characteristics, the taxon is described here as a new genus.

TAXONOMY

Coprotiella Jeng & Krug gen. nov.

Ascocarpia dispersa vel gregaria, sine stromate nec ostiolo, subglobosa vel globosa, primum hyalina, deinde cremea vel flavida, glabra; peridium membranaceum, pseudoparenchymatosum, cremeum vel flavidum. Asci unitunicati,

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[1] Supported by grants from the National Research Council of Canada.

iodo non caerulescentes, late clavati, evanescentes, non uncinati neque apparato apicali praediti. Paraphyses nullae. Ascosporae unicellulares, leves, hyalinae, tenuitunicatae, plerumque bullulas conspicuas exhibentes, sine foramine vel fissura germinationis; vagina gelatinosa nulla. Conidia incognita.

TYPUS GENERIS: Coprotiella gongylospora Jeng et Krug.

ETYMOLOGY: Derived from the generic name Coprotus and the diminutive suffix -ellus, referring to the similarity to the genus Coprotus.

Ascocarps scattered or gregarious, non-stromatic, non-ostiolate, subglobose to globose, hyaline at first, becoming creamy or yellowish, glabrous; peridium membranaceous, pseudoparenchymatous in surface view, creamy or yellowish. Asci unitunicate, non-amyloid, broadly clavate, evanescent, without croziers or apical apparatus. Paraphyses lacking. Ascospores one-celled, smooth, hyaline, thin-walled, at maturity usually possessing a conspicuous de Bary bubble; germ pores or germ slits lacking; gelatinous sheath absent. Conidial state unknown.

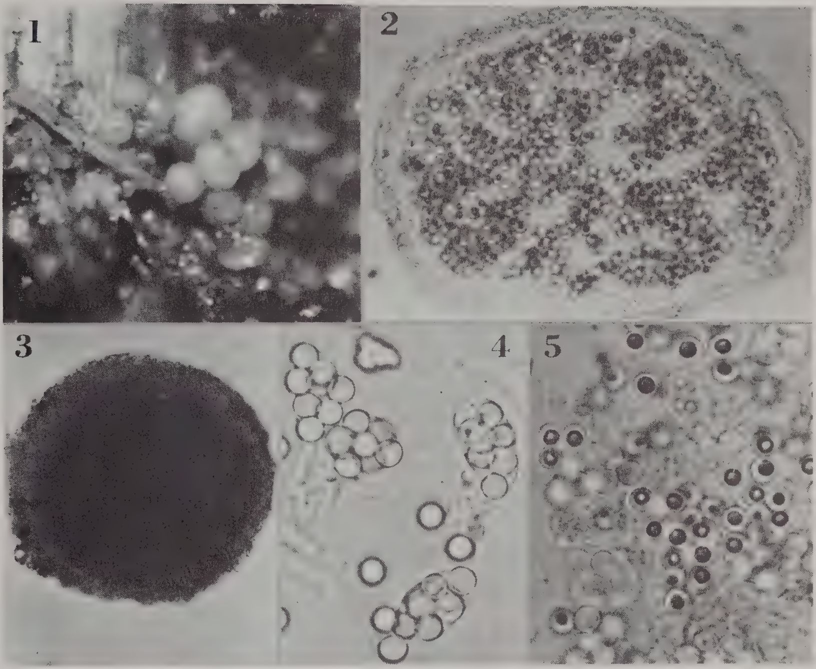
Coprotiella gongylospora Jeng & Krug sp. nov. Figs. 1-5.

Ascocarpia dispersa vel gregaria, non ostiolata, subglobosa vel globosa, 140-290µm diametro crassa, primum hyalina, deinde cremea vel flavida, glabra; peridium membranaceum, pseudoparenchymatosum, 9-12µm crassum, textura angulari vel textura globulosa in uno strato compositum, cellulis 3-14 x 3-6µm magnis. Asci unitunicati, iodo non caerulescentes, octospori, subglobosi vel late clavati, basin versus in stipitem brevem contracti, 24-31 x 13-21µm magni, evanescentes. Ascosporae unicellulares, globosae, 5.6-6.3µm diametro crassae, hyalinae, leves, tenuitunicatae, plerumque bullulas conspicuas exhibentes.

HOLOTYPUS: in equorum fimo lectus est, in loco a Cafayete 40 km meridionali remoto, in via 40 vocata, in Tucuman provincia reipublicae Argentinensis, 31 Mart. 1974, Mares C1387b. In Torontoensis universitatis Cryptogamarum herbario.

ETYMOLOGY: Greek, gongylos = ball, and spora = seed, referring to the globose shape of the ascospores.

Ascocarps scattered or gregarious, non-ostiolate, subglobose to globose, 140-290µm in diameter, hyaline at first, becoming creamy or yellowish, glabrous; peridium membra-



Figs. 1-5. Coprotiella gongylospora. 1. Habit view of the ascocarps. x36. 2. Longitudinal section of an ascocarp. x295. 3. Ascocarp in optical view. x176. 4. Young asci and ascospores. x590. 5. Mature asci and ascospores, showing the de Bary bubbles. x590.

naceous, pseudoparenchymatous in surface view, occasionally intertwined with filamentous hyphae, 9-12µm thick, creamy or yellowish, one-layered in section, consisting of textura angularis to textura globulosa, with cells measuring 3-14 x 3-6µm. Asci unitunicate, non-amyloid, 8-spored, subglobose to broadly clavate, short stipitate, 24-31 x 13-21 µm, evanescent, without croziers or apical apparatus. Paraphyses lacking. Ascospores one-celled, globose, 5.6-6.3µm in diameter, hyaline, smooth, thin-walled, at maturity usually possessing a conspicuous de Bary bubble; gelatinous sheath absent; germ pores or germ slits lacking. Conidial state unknown.

HABITAT: on horse dung.

SPECIMEN EXAMINED: ARGENTINA: Tucuman Prov.: along Hwy. 40, 40 km S of Cafayete, horse dung, 31 Mar. 1974, Mares C1387b (TRTC).

DISCUSSION

Coprotiella is similar in many ways to Coprotus Korf et Kimbrough. The ascocarps are likewise slightly coloured, the peridium is composed of textura globulosa to textura angularis like the excipulum in species of Coprotus, and the ascospores at maturity are mainly hyaline with a conspicuous de Bary bubble. On the contrary Coprotiella differs from Coprotus in possessing ascocarps which remain closed at all stages of development and asci which are subglobose to clavate, evanescent, and probably irregularly disposed. Coprotiella is also similar to Cleistothelebolus Malloch et Cain and Lasiobolidium Malloch et Cain but differs primarily from both genera in having ascospores possessing de Bary bubbles.

Malloch and Cain (1971) erected two new genera, Cleistothelebolus and Lasiobolidium, which were considered as the respective cleistothecial counterparts of the discomycetes Thelebolus Tode ex Fr. and Lasiobolus Sacc. Both Cleistothelebolus and Lasiobolidium were placed along with Eoterfezia Atkinson, Microeurotium Ghatak, Orbicula Cooke and Xeromyces Fraser in the Eoterfeziaceae. Undoubtedly Warcupia Paden et Cameron (1972) and perhaps even Monascus van Tiegham are also related, although at present it seems appropriate to retain Monascus in a separate family.

It has been accepted by a number of workers (Malloch, 1970; Lundqvist, 1972; Müller and von Arx, 1973) that closely related ostiolate and cleistothecial genera are better accommodated in one rather than in separate families as originally suggested by Cain (1956) who was followed in this respect by various other workers. Accordingly, it would seem appropriate to place Cleistothelebolus and Lasiobolidium along with Thelebolus and Lasiobolus in the same family. Similarly Coprotus and Coprotiella would belong in one family. In his recent concept of the Pezizales, Korf (1972) placed those operculate discomycetes that are fimicolous, with ascocarps reduced in size and complexity, possessing non-amyloid asci, with smooth, hyaline ascospores in the Pyronemataceae tribe Theleboleae while Eckblad (1968) would treat this taxon at the family level. We are following Korf and placing Cleistothelebolus, Coprotiella, and Lasiobolidium along with their discomycetous counterparts in the tribe Theleboleae. Except for its terricolous habit, Warcupia also seems to possess morphological and developmental features characteristic of this taxon. Although discomycetous connections have not yet been established, the remaining genera in the Eoterfeziaceae are obviously closely related to those in this tribe. Accordingly Eoterfezia, Microeurotium, Orbicula, Warcupia and Xeromyces are transferred to the tribe Theleboleae of the Pyronemataceae.

ACKNOWLEDGMENTS

We wish to express our appreciation to Dr. D.W.Malloch (Toronto) for confirming the identity of the fungus. Dr. J. A. von Arx (Baarn) has made a number of helpful suggestions while Dr. W.Gams (Baarn) has improved the Latin diagnoses for which we are especially thankful.

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REVUE DES LIVRES

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GUIDE TO AQUATIC HYPHOMYCETES. AN ILLUSTRATED GUIDE TO AQUATIC AND WATER-BORNE HYPHOMYCETES (FUNGI IMPERFECTI) WITH NOTES ON THEIR BIOLOGY, par G. I. INGOLD. Freshwater Biological Association, Scientific Publication no. 30, 96 p., 39 figs., broché, 1975. Freshwater Biological Association, The Ferry House, Ambleside nr. Windermere, Cumbria LA22 8LP, UK. Prix: £1.oo.

Ce petit livre est bien un guide. Il vous donne l'envie d'aller récolter et examiner les feuilles mortes submergées au bord des ruisseaux avant que la pollution n'en détruise la richesse de la fonge aquatique.

Dans l'introduction, on apprendra que, pour être "aquatique", un champignon doit être capable de développer l'entièreté de son cycle - croissance, reproduction, libération, dispersion - sous l'eau. La conidiogénèse des Hyphomycètes, même exogène, aura lieu sous l'eau. C'est là une capacité qui n'en exclut pas d'autres, comme celle de se développer aussi dans des situations terrestres, telles que les litières humides. Il s'agit d'un groupe "biologique" plutôt qu'un groupe "naturel" d'organismes par leurs affinités taxonomiques ou phylogénétiques. Par exemple, deux espèces d'Anguillospora seraient les stades conidiens d'ascomycètes de genres différents, Massarina et Mollisia. Il faut cependant admettre que ce groupe "biologique" d'organismes est bien naturel par la convergence de ses adaptations au milieu dans la forme et les besoins. 126 espèces, classées dans 46 genres, sont décrites et illustrées. Elles comprennent 121 Hyphomycètes, 1 levure imparfaite, 2 Spaeropsidales, 1 Basidiomycète imparfait et 1 Zoopagacée, ces cinq derniers étant donnés comme "non-hyphomycètes". Les Hyphomycètes hyalins sont répartis en trois groupes suivant leur conidiogénèse: 24 genres produisent des thalloconidies, 5 genres ont des phialoconidies et 2 des blastoconidies. Cependant les genres à conidies filiformes (2 phialosporés et 3 thallosporés) sont curieusement classés séparément de même que 5 genres d'Hyphomycètes dématiés. Dans cette classification plutôt pragmatique que taxonomique, les genres à "thalloconidies" dominent. Celles-ci sont surtout des conidies terminales à septum de base du diamètre de l'hyphe conidiogène et diffèrent certainement des blastoconidies du genre Drechslera que l'auteur (p. 9) prend en exemple pour elles.

Le fait que 19 espèces d'Hyphomycètes et 14 types de spores restent sans nom, montre combien ce groupe de champignons méritent l'attention.

IMPORTANT DISEASES OF FOREST TREES. CONTRIBUTIONS TO MYCOLOGY AND PHYTOPATHOLOGY FOR BOTANISTS AND FORESTERS, par R. HARTIG.

Phytopathological Classics no. 12, traduit de l'allemand par W. MERRILL, D. H. LAMBERT et W. LIESE, 22 + 120 p., 1 photo, 160 figs. en 6 pls., 8°, relié, (1874) 1975. The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minn. 55121. Prix: US $ 4.5o.

La Société Américaine de Phytopathologie a très heureusement choisi de publier, comme Classique de la Phytopathologie, la traduction de l'ouvrage de Robert Hartig, considéré comme la base de la pathologie forestière. La traduction reproduisant de près le fond et la forme du texte original et la reproduction fidèle des lithographies originales nous permettent d'aprécier toute la minutie et l'objectivité de Hartig dans son observation, il y a 100 ans, des grandes maladies de nos forêts dues à *Armillaria mellea*, *Trametes pini*, *Trametes radiciperda*, *Aecidium pini*, *Caeoma pinitorquum*, *Caeoma laricis*, *Peziza willkommii*, *Hysterium macrosporum*, *Hysterium nervisequium* et *Melampsora salicina*. Un retour aux sources qui vaut la peine.

ANNUAL REVIEW OF PHYTOPATHOLOGY, VOL. 13, édité par K. F. BAKER, G. A. ZENTMYER et E. B. COWLING, 12 + 412 p., ill., 8°, relié toilé, 1975. Annual Reviews Inc. 4139 El Camino Way, Palo Alto, California 94306. Prix: US $ 17.5o.

Chacun connaît la qualité des 12 premiers volumes des Annual Reviews of Phytopathology et leur impact dans l'avancement de cette discipline. Cependant on apréciera, dans ce 13e volume, la publication de 5 articles plus mycologiques.

Dans Variation and Speciation in the Fusaria, T. A. Tousson et P. E. Nelson comparent fort objectivement les systèmes de Snyder et Hansen, de Messiaen et Cassini et de Booth, mais sans y inclure celui de Wollenweber et Reinking, la base des autres. Dans The present status of *Fusarium* taxonomy, C. Booth démontre la nécessité de stabiliser la nomenclature de ce genre par le choix d'un matériel type nouveau (néotypes) vivant.

La nature, la morphogénèse et le rôle des appressoria d'une part et des sclérotes d'autres part sont revues de manière intéressante par L. W. Emmet et D.G. Parbery et par J. Chet et Y. Henis.

Mais on ne peut taire la remarquable réflexion que nous propose J. Walker sur les Mutual Responsibilities of Taxonomic Mycology and Plant Pathology. Si d'une part se manifeste une sorte de retraite monastique, on constate d'autre part une apathie certaine. Dans une analyse sincère de cet état de choses, l'auteur entraine le lecteur à une prise de conscience des remèdes. Certainement l'auteur appelle à plus de coopération mutuelle. Tant de poubelles, de laboratoires phytopathologiques regorgent de beaux spécimens de plantes malades porteurs du champignon pathogène tandis que l'herbier mycologique voisin n'a pas de specimen de ce champignon ou n'a que quelques spécimens obtenu en échange d'un pays étranger. Il serait cependant simple et profitable de confier ces échantillons au taxonomiste en y adjoignant les informations indispensables d'hôte, de localité de collecteur et de date. Dans d'autres cas, au contraire, le taxonomiste est mis à contribution presque sans considération, dans l'identification de nombreux "isolements" de champignons de plantes malades ou du sol. Il arrive si souvent que ces "isolements" présentent des associations étranges de caractères ou de sporulation qui en feraient de nouvelles espèces ou sont au contraire stériles: mais ce sont des cultures mixtes de plusieurs espèces fongiques ou encore de champignons, de bactéries, et même encore d'amibes, de nématodes ou d'acariens. Ainsi cet Humicola sp., présumé mycorhizique, qui devait se révéler comme nouvelle espèce, si son mycélium blanc abondant n'avait été celui d'un Mortierella ne sporulant plus par suite de la présence de bactéries et ses chlamydospores celles d'un Phialophora dont la conidiogénèse était inhibée au sein de l'association. Si le taxonomiste doit commencer l'identification d'une souche de Penicillium par la séparation des deux taxa voisins qu'elle contient par voie de cultures monogermes, il ne faut pas s'étonner de devoir attendre le résultat. Que J. Walker soit remercié pour la sincérité de son appel à plus de considération mutuelle.

BIOLOGICAL TRANSFORMATION OF WOOD BY MICROORGANISMS, édité par Walter LIESE, 203 p., 53 figs., 8°, broché, 1975. Springer Verlag, Heidelberger Platz 3, D-4023 Berlin-West. Prix: DM 32.oo, US $ 13.8o.

Communications à la Session "Wood Products Pathology" du 2e Congrès International de Phytopathologie de Minnéapolis, les 10-12 septembre 1973 par 18 spécialistes de la biodégradation du bois. Ce rapport fait état des recherches récentes sur la colonisation du bois par les champignons, la succession des flores, leurs relations avec la nature du bois et sa résistance spécifique, la position du bois par rapport à l'inoculum (sol), la profondeur de pénétration, les antagonismes et synergies, les effets et les mécanismes physiques et chimiques de la dégradation. Corrélativement, on trouvera aussi des données critiques sur les méthodes d'investigation et de "testing" du bois en vue de sa protection.

MULTILINGUAL COMPENDIUM OF PLANT DISEASES. COMPENDIUM POLYGLOTTE DES MALADIES DES PLANTES, par Paul R. MILLER et Hazel L. POLLARD, 457 p., 325 col. figs. in 36 pls., 4° relié,1976. The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minn. 55121.Prix: US $ 36.oo.

Ce Compendium a pour but de faciliter la communication à travers le monde dans le domaine de la protection des cultures en cataloguant et clarifiant la dénomination des maladies dans 21 langues différentes et en fournissant une description synthétique de chacune des 325 maladies en 4 langues, anglais, français, espagnol et "interlingua". L'enquête a été limitée aux maladies dues aux champignons et aux bactéries. Chaque maladie est dénommée et classée alphabétiquement par le nom latin de l'hôte principal + le nom du pathogène. Chaque maladie, sauf 43, est illustrée par photographie en couleurs de petites dimensions (5 x 5 cm) mais de bonne qualité. Des index des hôtes, des pathogènes et des maladies, sur plus de 120 pages, complètent utilement l'ouvrage.

THE CHEMOTAXONOMY OF PLANTS, par P. M. SMITH, in coll. Contemporary Biology, édité par E. J. W. BARRINGTON et A. J. WILLIS, 313 p., ill., broché, 1976. Edward Arnold, 25 Hill Street, London W1X 8LL. Prix: relié £ 13.oo, broché £ 6.5o.

L'auteur tente d'explorer l'immense champ de rencontre entre taxonomistes et chimistes, de manière à mieux servir la taxonomie des plantes (seuls quelques exemples concernent les champignons et les bactéries). Dans une première partie, l'auteur définit très bien la place de la chimiotaxonomie et analyse sa démarche: partant d'une taxonomie classique des organismes d'une part et des possibilités offertes d'analyses chimiques d'autre part, le chimiotaxonomiste accumule des données qu'il interprétera en vue d'une confirmation ou d'une modification de la taxonomie préétablie et éventuellement en vue d'une construction phylogénétique. Dans une seconde partie, les diverses sources d'information chimique sont alors évaluées, sur la base d'exemples, pour leur utilité en taxonomie: amino-acides, phénols, bétalaînes, huiles, cires, hydrates de carbone, alkaloides, terpénoïdes, stéroides, protéines et acides nucléöques. Dans une dernière partie, les promesses et les limitations de la chimiotaxonomie sont formulées avec lucidité. Ce livre d'une lecture facide, aidera le taxonomiste et le chimiste à se rencontrer.

BIOLOGICAL IDENTIFICATION WITH COMPUTERS, édité par R.J. PANKHURST, The Systematics Association Special Volume no. 7, 333 p., 33 figs., 8°, relié, 1975. Academic Press Inc., 24-28 Oval Road, London NW1, 111 Fifth Ave, New York, NY 10003. Prix : £ 11.oo.

Ce livre publie les 16 communications offertes à la conférence organisée par la Systematics Association à Cambridge les 27-28 septembre 1973, dans le but de définir les possibilités et les limites de l'ordinateur dans l'identification des organismes vivants. Il apparaît que l'ordinateur ne se substitue pas encore au biologiste dans l'observation de départ. Son rôle se limite à reproduire et peut-être standardiser (ou "modeler") la procédure de décision. Beaucoup de travaux ont été réalisés sur l'usage de l'ordinateur pour la classification (voir taxonomie numérique), mais peu encore pour l'identification, endehors du domaine du diagnostic médical dont il n'est pas ici question. Cette synthèse des connaissances commence par une analyse conceptuelle des mécanismes essentiels de l'identification et ensuite détaille les divers procédés offerts par l'ordinateur: la construction de clés dichotomiques, de clés à entrées multiples, l'identification par approche globale, par tests multiples et dépendants, par clés binaires et coefficient de similitude, l'identification par la probabilité, par les distances euclidiennes ou les coefficients de corrélation, et même l'identification par reconnaissance des charactères des spécimens ("Pattern Recognition") et même l'identification par conversation en ligne (procédé question-réponse). Ces techniques présuppose une observation ordonnée des caractères selon un programme qui peut être élaboré par ordinateur. Ces recherches finissent par faire appel à une nouvelle forme de perfection des descriptions taxonomiques. Elles amènent aussi le taxonomiste traditionnel à repenser les principes de son activité, d'en découvrir les mécanismes profonds, de les expérimenter et les modifier en vue de les rendre communicables et reproductibles. Cet ouvrage, technique sans doute mais d'un style clair, est une heureuse réflexion sur une phase essentielle du travail taxonomique.

LICHENOLOGY: PROGRESS AND PROBLEMS, édité par D. H. BROWN, D. L. HAWKSWORTH et R. H. BAILEY. The Systematics Association Special Volume no. 8, xii + 554 p., ill., 8° relié, 1976. Academic Press, London, New York. Prix £ 19.oo.

La lichénologie fait de grand progrès durant ces récentes années, grâce aux nouvelles techniques d'approche et stimulé par les problèmes d'environnement et de pollution. Ce livre résulte du Symposium international tenu à l'Université de Bristol les 8-10 avril 1974. Ses 20 contributions reflètent bien les orientations de recherche actuelles: l'ultrastructure des lichens par SEM et TEM, l'étude morphologique du développement et de la fructification, l'étude taxonomique du phycobionte, les facteurs écologiques de la distribution des lichens, le taux de croissance des lichens et l'âge des supports, les adaptations des lichens à des milieux particuliers tels que les matériaux ou le milieu marin, l'absorption de SO2 et de minéraux dans les milieux pollués, la physiologie et le métabolisme des lichens et enfin la nature profonde de la symbiose lichénique analysée dans ses principes ou dans son entité comme écosystème. Ce livre montre combien les lichens, par les mystères de leur "vie à deux" méritent l'attention d'un très large public.

ENDOMYCORRHIZAS, édité par F. E. SANDERS, Barbara MOSSE et P.B. TINKER, xiv + 626 p., ill., 8°, relié,(1975) March 1976, Academic Press, London, New York. Prix: £ 9.6o.

Proceedings of a Symposium held at the University of Leeds, 22-25 July 1974. Cet ouvrage complète très bien cet autre édité par G. C. Marks et T. T. Kozlowski sur les "Ectomycorrhizae, their ecology and physiology" (Academic Press,1973). La plupart des 41 communications se concentrent sur les endomycrhizes vésiculaires et arbusculaires, sans négliger les autres endomycorhizes, en particulier des Orchidées et des Ericacées. On y parle de l'évolution de la classification et de la culture des endophytes, de leur physiologie, de leur ultrastructure, des relations et interactions entre le champignon, l'hôte et le milieu (carbohydrates, phosphore) et enfin de l'interférence des fertilisants et des fongicides sur la symbiose. Ce livre, le plus récent sur les endomycorhizes, sera une base de référence dans toute nouvelle investigation.

DE NEDERLANDSE MYXOMYCETEN, par N. E. NANNEGA-BREMERKAMP, Publication no. 18, 440 p., 1000 figs., relié toilé, 1974. Koninklijke Nederlandse Natuurhistorische Vereniging, B. Hoogenboomlaan 24, Hoogwoud 1743, Nederland. Prix: DFl 70.oo, US $ 21.oo.

Madame Nannega-Bremerkamp dédicace son livre à son père, son époux et ses enfants et l'adresse aux lecteurs en ces termes : "Zoekt, vindt en geniet" (cherche, trouve et jouis). L'auteur exprime là la patience de sa recherche, le dynamisme de sa découverte et l'enthousiasme de son admiration de la nature. En 25 années, elle est arrivée à découvrir au Pays-Bas 266 espèces de Myxomycètes qu'elle décrit avec soin et illustre de beaux dessins à la plume aux grossissements de 10 à 1000 X. Dans 13 planches hors texte, elle compare encore en détail (2000 X) les spores de 182 espèces.

Des notes taxonomiques fournissent la distinction d'avec les espèces qui n'ont pas été trouvées aux Pays-Bas. Elles pousseront sans doute vers de nouvelles découvertes.

Bien qu'écrit en néerlandais, ce livre aura une audience beaucoup plus large du fait de ses qualités scientifiques et de l'importance de sa contribution pour la mycoflore d'Europe. Il faut en féliciter l'auteur et venir apprendre avec elle l'art de cultiver les Myxomycètes dans son propre jardin, de les y observer chaque jour et les admirer.

INTRODUCTION TO THE HISTORY OF MYCOLOGY. par G. C. AINSWORTH, xi + 359 p., 106 figs., 8°, relié, 1976. Cambridge University Press, Trumpington Street, Cambridge CB2 1RP, or 32 East 57th Street, New York, NY 10022. Prix: £ 11.00.

Quel plaisir la lecture de ce livre raffiné par son style et le choix de son illustration ne donnera-t-elle pas à tout mycologue, à tout botaniste et à quiconque est curieux de regarder vers ceux qui furent à la source de nos connaissances. En frontispice, une planche coloriée de Bulliard (1791) et en couverture, le médaillon gravé du *Selecta fungorum carpologia* des frères Tulasne montrent d'emblée l'appréciation esthétique et le bon jugement scientifique et historique de l'auteur.

La mycologie a de multiples aspects, son histoire de même. L'auteur les considérera séparément. D'abord ce qu'ont été les champignons et leur statut en science naturelle, ensuite leurs formes et leurs structures telles qu'elles furent observées avec les instruments de chaque époque, puis leur nutrition et leur culture. La découverte de leur polymorphisme, de leur sexualité, de leur génétique furent des étapes passionnante. Mais aussi, depuis longtemps, l'alarme a été lancée sur leur pathogénécité, leur toxicité, leurs effets hallucinogénique et allergénique, malgé un usage plus que millénaire. L'exploration du monde eut ses époques, de même la découverte des champignons et de leur distribution. Avec l'accumulation des données, la classification aussi évolua beaucoup, marquée par les synthèses d'hommes fameux. La mycologie est enfin affaire d'hommes qui seuls ou groupés en sociétés en ont fait une science et l'activité humaine que nous connaissons.

Non seulement agréable à lire, ce livre est aussi un document scientifique, rigoureux et critique. C'est aussi un livre stimulant la réflexion sur les possibilités futures de la mycologie.

MORE DEMATIACEOUS HYPHOMYCETES, par Martin B. ELLIS, 507 p., 383 figs, 8°, relié, 1976, Commonwealth Mycological Institute, Kew. Central Sale Branch, Commonwealth Agricultural Bureaux, Farnham Royal, Slough SL2 3BN, UK. Prix: £ 18.oo.

Après le premier volume "Dematiaceous Hyphomycetes" publié par l'auteur en 1971, on accueillera avec plaisir ce nouveau volume d'ailleurs aussi important puisqu'il contient la description de 732 autres espèces d'Hyphomycètes. Alors que le premier volume abondait en champignons lignicoles, on trouvera dans celui-ci une revue plus large des genres communs tels que *Alternaria*, *Cladosporium*, *Cercospora*, *Drechslera*, *Phialophora*, *Stachybotrys*. On y trouvera aussi 10 genres nouveaux, 61 nouvelles espèces et 119 noms et combinaisons nouvelles.

Une fois de plus l'auteur est à féliciter pour la technicité de ses ses descriptions et l'excellence des dessins qu'il fournit pour chaque espèce. Sans aucun doute, ce travail magistral sera consulté par tous ceux qui étudient les Hyphomycètes.

REVISION OF THE SUBSECTION FASCICULATA OF PENICILLIUM AND SOME ALLIED SPECIES, par R. A. SAMSON, Amelia C. STOLK et R. HADLOK. Studies in Mycology, no. 11, 47p., 15 figs., 1976. Centraalbureau voor Schimmelcultures, Baarn, Pays-Bas. Prix Dfl 15.oo.

L'étude d'un grand nombre de souches de *Penicillium* asymétriques des sous-sections *Fasciculata*, *Lanata* et *Funiculosa* de Thom et Raper conduit les auteurs à réévaluer les caractères diagnostiques et n'accepter comme critère fondamental que la morphologie de l'appareil conidien. Les caractères de couleur, de texture et de croissance, utilisés par Thom et Raper comme diagnostiques de séries ou de sous-sections, sont considérés ici comme variables et de valeur secondaire.

Il en résulte des modifications taxonomiques importantes.
Les espèces *Penicillium puberulum*, *martensii*, *aurantiovirens*, *crustosum*, *lanosocoeruleum*, *biforme*, *lanosogriseum*, *terrestre*, *aurantiocandidum* et *solitum* deviennent synonymes de *P. verrucosum* var. *cyclopium* (*P. cyclopium*),
P. lanosoviride et *psittacinum* synonymes de *P. verrucosum* var. *verrucosum* (*P. viridicatum*),
P. carneolutescens synonyme de *P. verrucosum* var. *ochraceum* (*P. ochraceum*), et *P. resticulosum* synonyme de *P. expansum*.
P. griseofulvum reprend sa priorité sur P. *urticae*.
P. cyclopium var. *album* devient *P. verrucosum* var. *album*.
P. corymbiferum et *hirsutum* deviennent *P. verrucosum* var. *corymbiferum*.
Les espèces *P. expansum*, *P. italicum*, *P. granulatum*, *P. claviforme*, *P. clavigerum*, *P. isariiforme*, *P. lanosum* et *P. commune* sont maintenues, auxquelles s'ajoutent *P. hordei* Stolk et *P. echinulatum* Fassatiova et 1 espèce, *P. concentricum*, et 2 variétés nouvelles *P. italicum* var. *avellaneum* et *P. verrucosum* var. *melanochlorum* que décrivent les auteurs.

Il est difficile de mettre en question la précision de la méthode et la qualité de l'observation à la base de ce travail. Cependant il faut admettre que le lecteur qui, depuis 20 ou 30 ans, a reconnu avec Thom et Raper tant d'espèces proches comme distinctes par la couleur ou la fasciculation sera d'abord étonné, puis déçu parce que voulant comprendre il ne trouvera pas la démonstration convaincante de l'identité des espèces mises en synonymie. Il eut fallu plus qu'une simple affirmation d'identité, plus qu'une figure de 3 conidiophores sans indication d'origine pour prouver et faire accepter l'identité de 17 souches types d'espèces différentes à une seule, *P. verrucosum* var. *cyclopium*. Sur quels caractères trompeurs *chacune* de ces 17 espèces synonymes ont-elles pu être reconnues comme distinctes, pour ne plus l'être aujourd'hui. C'est cette analyse de cas particuliers que le lecteur désireux de comprendre ne trouve pas.

Il est certain que dans ce travail transparaît une optique nouvelle sur la systématique des *Penicillium*, qui mérite toute l'attention des mycologues et microbiologistes.

INDEX TO FUNGOUS AND LICHEN TAXA

This index includes genera, infrageneric taxa, species, and infraspecific taxa. New taxa are in CAPITALS, and the pages where they are published are in *italics*. Gilliam's monograph of *Marasmius* is separately indexed (pp. 140-144), Petersen's index to Schaeffer's "Bavarian Fungi" is itself an index (pp. 147-153), and Sigler & Carmichael's monograph of *Malbranchea* and allied genera is also separately indexed. References to these indices are indicated by the notation "*see*". The list of epithets on pp. 191-209 is also not indexed here.

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